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ABSTRACT

This document is a collection of project reports from the Information System for Vocational Decisions (ISVD), which is designed to meet the vocational needs of users from kindergarten through retirement by providing occupational facts and/or data which can be converted into vocational information. The project reports cover such concepts as organization, rationale, goals, implications, occupational forecasting, electronic data processing, guidance machines, and decision-making. The technical memorandum, "Forecasting for Computer Aided Career Decisions: Survey of Methodology" is included in the collection. A related document is VT 015 072 in this issue. (BH)

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INFORMATION SYSTEM for VOCATIONAL DECISIONS.
MISCELLANEOUS PROJECT REPORTS

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Graduate School of Education
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INFORMATION SYSTEM FOR VOCATIONAL DECISIONS

Project Report No. 1

THE ORGANIZATION AND INTENTION OF A PROPOSED DATA AND EDUCATIONAL SYSTEM FOR VOCATIONAL DECISION-MAKING*

David V. Tiedeman

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Graduate School of Education
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THE ORGANIZATION AND INTENTION OF A PROPOSED DATA AND EDUCATIONAL SYSTEM FOR VOCATIONAL DECISION-MAKING

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Job Placement from College within an Information System for Vocational Decisions

The Information System for Vocational Decisions which I describe and discuss in this paper is to accommodate, in potential, the vocational needs of users extending from the kindergarten to retirement. The System is to be designed and staffed so that, with appropriate use throughout life, occupational facts and/or data (hereafter, facts/data) can be converted into vocational information by means of personal inquiry which is at least initially conducted under supervision of a professional counselor. Job placement upon leaving college, one-half of the interest among Conferees, thus becomes a specific, but intermediate, part of the Information System for Vocational Decisions, the other half of the interest among Conferees.

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[1] Harvard Studies in Career Development, No. 42. Paper prepared for Invitational Conference on Career Development and Placement of College Graduates (Comparison of Theories and Practices), 3-4 December 1965. Conference is sponsored by Office of Placement, Wellesley College and Center for Research in Careers, Graduate School of Education, Harvard University.
I am heavily indebted both to Mrs. Eileen Morley, Research Assistant, Center for Research in Careers, for criticism and revision of an earlier draft of this paper and to Professor Warren D. Gribbons, Regis College, for a summer seminar on an Information System for Vocational Decisions.

The primary goal of this proposed System is to bring a person to a condition of readiness and confidence at each of the several discontinuities of vocational development: readiness insofar as an individual may develop a plan in relation to which action is possible; confidence sufficient that action may be initiated. The secondary goal of this proposed System is to permit the accumulation of data about vocational decision-making, as it is experienced and undertaken by the individual.

These goals, stated briefly at the outset for the sake of clarity, subsume a number of propositions which are elaborated in the sections which follow. These are:

1. a recapitulation of the line of thought which has led me from consideration of self-concept to personal determination in career development;
2. an account of the organization and functional intention of the proposed Information System;
3. specification of the machine routines required by such a System;
4. an outline of some of the materials and forms of presentation necessary at the several age levels so far planned for the System; and
5. consideration of the existence of such an information system in relation to problems of vocational readiness and placement of college graduates.

The fact that problems associated with the placement of college students form a major sector of the repertoire of such a System causes me to presume upon your time with this paper.

However, I have an additional reason for sharing it with the Advisory Committees and friends of the Center for Research in Careers. Approximately four years ago, Donald Super was kind enough to join Henry Borow, Jean Jordaan, Robert O'Hara, Ted Volsky and me in preparing a set of monographs under commission from the College Entrance Examination Board. In the course of discussions in what turned into a seminar, I became fascinated by the possibility of delineating personal determination of career within Super's concept of vocational development. That possibility has directed my thought since publication of my monograph with O'Hara (Tiedeman and O'Hara, 1963). I attempt to draw these threads together here because they underlie my proposal for an Information System for Vocational Decisions. The Information System will, in turn, and if supported, constitute the next major phase of my effort to provide a system of thought within which it is possible to comprehend somewhat more, the theory, processes and data of self-determination in career development.

From Self Concept to Personal Determination in Career Development

Super's 1963 Statement of Self-Concept Theory.

Professor Super assumed responsibility during our College Board seminar for drawing together research on self concept and for reformulating his theory on the self concept in vocational development. The results of that work appear in the monograph Career Development: Self-Concept Theory (Super, Starishevsky, Matlin, and Jordaan, 1963).

Super's discussions and essays growing from the seminar took three essential directions:

1. the placing of self concepts into a theory of vocational development;
2. the provision of more operational statements of the development of self concepts; and
3. the specification of the tasks of vocational development encountered in adolescence and young adulthood.

In addition, Super supervised the preparation by Reuben Starishevsky and Norman Matlin of an essay on the translation of self concepts into vocational terms. Super also stimulated his colleague, Jean Pierre Jordaan, to provide an essay on exploratory behavior. In this essay Jordaan was interested in the origination of self and occupational concepts.

Robert O'Hara and I were privileged to meet regularly with Super and his group in the process of framing the essays which I have just noted. O'Hara and I were engaged in:

1) expanding our understanding of a chosen alternative into an understanding of a process of choosing; and
2) relating the development of the process of choosing in vocational life to Erikson's (1959) psycho-social process of identity formation.

Jordaan, O'Hara, Super and I were further privileged to have Henry Borow and Ted Volsky, who were both then at the University of

Minnesota (Volsky has since moved to University of Colorado), as participating members of the College Board seminar. In reflecting, under criticism, upon the ideas of Jordaan and Super and those of O'Hara and me it came clear to me that Super was engaged in advancing his thought by:

1. expanding Wylie's (1961) review of self concept theory by incorporating vocational choice as an additional means of self differentiation, an omission in Wylie's thought;
2. incorporating self concepts (note the plural form) as a primary term of self differentiation in contrast to his previous emphasis on self concept alone;
3. construing the union of self and vocation essentially as a translation; and
4. attributing motivation for the translation in 3) largely to external events known as "tasks of vocational development."

In contrast, Erikson (1959) analyzes the development of ego-identity in relation to modification in awareness of one's psychosocial position. Erikson's concept of "position" is at once social ("what they want me to be," so to speak) and personal (something in the individual's core). Thus, the ego development which Erikson sketches involves the incorporation of social roles into the ego through the mechanisms of the self, among other mechanisms. However, Erikson's ego development also involves the effect on social roles of psychological development should personal responsibility become operative.

O'Hara and I attempted to bring Erikson's conception of ego-development into Super's conception of self concept in vocational development. Our principle mechanism for the attempted union was the logic of decision-making. Decision-making was proposed as central in the more comprehensive mechanisms of differentiation and integration. Finally, decisions of vocational development were particularly construed as prime opportunity for the differentiation and integration of ego identity. Such differentiation and integration in turn develops the potential of decision in personal development.

Our effort to place decision in the center of the development of identity through vocation brought me to realization that I must then analyze the process of career development in terms of the potential growth in awareness of one's responsibility for vocational behavior. My habits as a former statistician make this realization difficult. Experiments in psychology do not ordinarily involve the subject as an agent in processing the seeming data from the experiment. Thought as a mechanism in behavior is therefore usually unanalyzed in psychology particularly in relation to the effect under specific investigation. Professor Super's thought during 1962-1963 was also bound by this restriction. This is why he, with Starishevsky and Matlin, attempted to invoke the formal concept of "translation" in seeking to operationalize the union of self and vocation. Furthermore, this is why "developmental tasks" becomes a prime term in his system of vocational development because initiation of development is kept external in the behavioral mode of analysis. Crites (1964) accepts similar limitation on his conception of vocational maturity.

Beginning with the College Board seminar, I have given serious consideration to the possibility that I can make science-like propositions about the actions of people when the data on which I base those science-like propositions are also provided for the person to whom I believe they apply. I thereby focus my interest on the process of knowing as has Bruner (1962). It is this belief which underlies my attempt to provide a prototype Information System for Vocational Decisions. In the presence of the Information System it is possible to analyze the non-appearance of the turning of facts/data into information. In the absence of the System it is not so possible. I intend to offer further statement of this belief. However, before doing so, I need delineation of three prior understandings which underlie my present belief.

The Ideal in the Self Concept. Prior to the College Board seminar I preferred to construe vocational behavior as primarily stemming from conceptions of self. In maintaining this preference, I frequently exasperated my collaborator, Robert O'Hara. However, my interest did lead me under O'Hara's guidance to comprehend the potential effect of personal impression upon a pattern of action.

I have noted that the College Board seminar, with its concomitant responsibility for an essay with O'Hara caused me to realize that I was avoiding consideration of a primary question in vocational development, namely, what is the origin of conceptions of self, the question which Roe and Siegelman (1964) ask in terms of the origin of interests. O'Hara and a then current student, Chris Kehas, brought the conception of "idealness" into my attention and the conception of "idealness" in turn became a bridge to my giving responsibility for personal determination a central position in my thought about career development. I therefore here next examine the bridge of "idealness."

Kehas first developed a critical review of the self concept (1962). His review notes the streams of research which have on the one hand dealt with stated conceptions of self and on the other with discrepancies between these conceptions and those which are considered to be ideal. It is the presumed need for consistency in actual and ideal conceptions of self which has directed the therapeutic interest in the self concept. It is conceptions of self which have influenced vocational study of self concept because of the need in vocational choice theory to attribute direction to interest and assessment of personal circumstance. Kehas clearly distinguished these two uses of self concept in his dissertation (1964) and successfully used the distinction in relating both self concept and conceptions of self to school achievement relative to expected level of attainment.

Purposeful Action and Career Development. Kehas joined Field and me (Field, Tiedeman, and Kehas, 1963) in proposing the incorporation of the concept of idealness into the problem of explaining the emergence of vocation in the self concept. The idealness concept provides a primary term within which it is then logically possible to construe the potential for direction in vocational behavior. However, the concept of idealness in turn offers two difficulties in theory, namely:

1) the source of the ideal may be construed as only external to the person and hence lead to illogical and sometimes even inflammatory considerations of both presence and time; and
2) the ideal logically bears no necessary connection with actual events because the person must himself forge a connection if the ideal is to guide action.

Kehas, Field, and I are in accord as to the advantage which incorporation of the concept of idealness holds for development of theory in career development. Kehas elected to study the conception itself in his dissertation. Field elected to make further analyses of the problems of presence and connection in his dissertation. Field's thought gave rise to his concept of purposeful action (Field, 1962 and 1964). In purposeful action, existence of a desired future state and of an awareness of a present state are both postulated. Furthermore, knowledge of a discrepancy between the desired and actual states is presumed to exist. Under such conditions it then becomes possible:

1) to think of ends and means;
2) to derive goals;
3) to plan;
4) to undertake activity under guidance of the plan which is designed to reduce the known discrepancy; and
5) to experiment with the use of means under guidance of plan until the end is accomplished or until realization begins to appear that ends and the whole structure of purpose must be shifted.

Purposing through Education. Purposeful action in no sense either determines completely from the outside the advisability of pursuing one end or another or guarantees the achievement of a desired end. Field deliberately defines purposeful action so that goal determination and risk are left as matters of both individual choice and intelligence. It has been for these reasons that I have given very serious consideration to using purposeful action as the goal of Guidance as organized within an educational frame (Tiedeman and Field, 1962; Tiedeman, 1964). Purposeful action permits the guidance practitioner to focus directly upon two professional problems, namely:

1) the exercise of individual choice; and

2) the exercise of intelligence in action.

Obviously I use the term "intelligence" in a wider sense from scholastic aptitude test scores. In fact I intend the term to connote the exercise of thought and judgment in bringing act and intention into relation so that accomplishments of credibility (as judged by others) are achieved.

The concept of purposeful action is by definition a static concept. It is analyzed in relation to a single choice situation. Concepts of plan and feedback within the general conception are themselves fluid or processional. However, the primary term is only understood in terms of a specific choice. Field and I have come to realization of this inherent limitation of our original proposition (1962). I have myself attempted to subsume this limit into a larger conception of more general power. I do so by thinking of purposeful action as being but a paradigm applicable in many circumstances. That overarching paradigm essentially places the sub-paradigm of purposeful action into the frame of time. Purposing, not purposes, then becomes the essential conception (Tiedeman, 1964).

I elect to conceive "purposing" in relation to an educational frame. I do so because that is where I believe that Guidance should be practiced. I do not limit meaning of "educational frame" to schools and colleges. However, I do limit meaning of the term to an institutionalized form of encouraging persons to become thoughtful about their action. By this means I seek societal sanction for the ethic I urge upon those I serve. Furthermore, I accept limit on my pursuit of that ethic. If society does not support me, I am with idea but without power.

The conception of "purposing" permits me to imagine opportunities throughout the school day and life in which invocation of the paradigm of purposeful action is possible. In relation to such possibilities the processes of purposeful action can be seen as potentially available to adult and student attention rather frequently. Furthermore, there is no reason for vocation to be the sole context in which such processes are brought into attention. Decisions of relationship in family, neighborhood, recreation, school subjects and life plans are all analyzable in the terms of this single conception. However, by attending to the process of, and skill in, deriving purpose throughout educational activity, it becomes possible to conceive of a developed sense of having purposed and of being responsible for what is happening to one. It is not that I want people to have purposes continuously. I merely want people:

1) to be capable because of education of having purpose when desired; and
2) to recognize that the analysis of personal activity in relation to the paradigm of purposeful action provides each of us with powerful means of understanding ourselves.

I care not, except as an educator, that people are rational. However, I do care as a Guidance practitioner in education that each person come to recognize as best he then can that irrationality can only be conceived in relation with rationality. It is not possible to be irrational unless one has a conception of rationality with which action is being compared. This is the goal I seek by purposing as a Guidance practitioner through education.

The Information System as a Means of Cultivating Vocational Purposing. I have so far indicated that my primary attention in understanding career development is presently given to incorporating the personal conception of idealness in the vocational self-concept, through application of the paradigm of purposeful action, with sufficient repetitiveness that mastery of the process of acting purposefully is achieved. This triplicity may be re-stated in the form of goals.

1) the incorporation of the personal conception of idealness in the vocational self-concept;
2) the use of the paradigm of purposeful action as a process model; and

3) the achievement of mastery over the process of acting purposefully, through repetitive practice.

The Information System is thus proposed as a means of achieving these goals by the provision of:

1) reality-based facts/data, in terms of which the individual may develop vocational self-concept (information) incorporating his own conception of idealness;
2) machine routines which permit the individual to participate in the System according to the paradigm; and
3) infinite opportunity for practice.

The Possibility for Science in Purposing through Education. I am also interested that vocational activity be a form of expression of purposeful action. Prior to the above excursion I had proposed that it is possible to frame science-like propositions with regard to the incorporation of facts/data by persons sharing many of the facts/data which behavioral scientists ordinarily exclude from consideration of their subjects. I return here to that assertion.

Field and I recently wrote of "Measurement for Guidance" (Tiedeman and Field, 1965). The preposition "for" is very deliberately placed in our title. Field and I wrote a statement which:

1) presents the ordinary paradigm of prediction through traits/factors (Tiedeman, 1956);
2) proposes that mastery of that paradigm be a responsibility not of the scientist alone but also of the person attempting to give direction to his life; and

3) explores the possibility of making science-like propositions about the process of incorporation which the person would use in turning the historical-type statements of behavioral science into information for himself in relation to growing knowledge of his intentional framework.

It is our belief that, if the scientist remains explicit about 1) and 2) above, he can accumulate records of the history of 3). These records can in turn provide data about which the scientist can then attempt to formulate explicit and reproducible statements about the phenomenon of a person involved in the incorporation of a process by which he can evolve and use a feeling of mastery over his vocational destinies. There rests my interest as a scientist in provision of a prototype for an Information System for Vocational Decisions. The System becomes the explicit representation of 1) and 2) above. Against this explicit frame it then becomes possible to encourage people to use the frame and to accumulate for their and my purposes a record of their thought as they attempt to turn facts/data into information at their several entries into interaction with the System.

As I engage in studies emanating from data of people using the prototype Information System, I will be laying out a part of the natural history of attaining vocational maturity within the times. In this regard I use the System and the ethic of purposing through education as necessary rudiments of my concept of "vocational maturity." Neither Super et al. (1963) nor Crites (1964) seem to include an ethic in their definitions of vocational maturity. I just have found no way to avoid doing so.

The Organization and Intention of a Proposed Information System for Vocational Decisions

Structure. The President and Fellows of Harvard College recently requested the U. S. Commissioner of Education to provide support under provisions of Section 4(c) of the Vocational Education Act of 1963 for the development and delivery of a prototype Information System for Vocational Decisions. I here attempt some indication of the breadth and depth of the proposed System by noting, through names and titles of its participants, the structure of its authority and skills. The request was forwarded by the Executive Committee of the intended System which is organized in the Graduate School of Education and consists of:

- E. Gil Boyer, Administrator, New England Education Data Systems
- Russell G. Davis, Lecturer on Education and Associate Director, Center for Studies in Education and Development
- Allan B. Ellis, Assistant Professor of Education and Director of Basic Research and Formal Instruction, New England Education Data Systems
- Wallace J. Fletcher, Associate in Education and Consultant in Technical, Vocational, and Adult Education for the Newton, Massachusetts School System
- Edward Landy, Professor of Education and Assistant Superintendent of Pupil Personnel Services and Special Education, Newton, Massachusetts School System
- Theodore R. Sizer, Dean, Graduate School of Education, *ex officio*.

I am chairman of this Executive Committee, and this permits collaboration between the System and the Center for Research in Careers.

The Executive Committee of the proposed Information System is to operate within policy formed by an Advisory Committee presently consisting of:

The members of the Executive Committee

Charles T. W. Curle, Professor of Education and Development and Director, Center for Studies in Education and Development

Herman Eschenbacher, Librarian, Graduate School of Education

Emmanuel G. Mesthene, Executive Director, University Program for Technology and Society

John P. Morine, Senior Supervisor, Occupational Information and Vocational Guidance, Division of Vocational Education, Department of Education, Commonwealth of Massachusetts

Norman Zachary, Director, Harvard Computing Center

In addition, in the event that the grant materializes, arrangements will be made, if possible, to have representation on the Advisory Committee from the College Entrance Examination Board; the Office of Placement, Wellesley College; and the Office of Manpower, Automation, and Training, U. S. Department of Labor. Representation from business and industry in New England as well as from WGBH, the educational television station in Greater Boston, is also considered desirable.

Function. The Information System for Vocational Decisions will be a computer-based system for the location and display of graded occupational facts/data. Display is to be by sound and sight with pictures and/or words as the medium for presentation of facts to sight.

The occupational facts/data of the System are to be graded so that they will be appropriate at various times to users ranging from four years of age to retirement. In each of such stages, it will also prove necessary to provide occupational facts/data so that they are: 1) both general and of varying degrees of specificity as well as 2) accurate as of the moment but capable of some relationship to categories of new possibilities according to the costs of thought, time, effort, and resource which will need to be associated with possible product and work organizations of the future.

Ethic. Computer-based displays of occupational facts/data must be considered foundational to, not determining of, career. Otherwise, responsibility for life will be left with the System, not assumed by the user. This risk challenges the Information System for Vocational Decisions. As indicated in the following section and in Appendix A, every effort will be devoted to providing safeguards in the computer-based programs against interpretations of predictions as unmodifiable determinants of career. Nevertheless, the officers who will mediate use of the System, namely counselors and placement officers, will need special instruction with regard to their responsibility for seeing that persons given access to the System eventually emerge from their System interactions understanding that they alone bear ultimate responsibility for their vocational endeavors. When users place themselves into relation with facts/data so that *responsible* actions of a vocational nature begin to develop in some measure, then will facts/data have been turned into information. This is the meaning of information which the System (computer routines and administrative officers) will be organized to promulgate, namely the transition of facts/data into information through development of the capacity to analyze and act upon intentions of vocational significance. Morley and I recently dubbed such a capacity "vocational competence" (Morley and Tiedeman, 1965).

Heuristics of the System. Our desire to emphasize individual responsibility for decision during interaction with the System places an important restraint upon the specifications of the System. Computer programs are to be merely heuristic, not determining. Although this distinction between heuristic and determinant may well prove hard to maintain, every effort will be made to develop programs which are only persuasively demonstrative, not logically compelling. Actually, healthy skepticism on the part of the user will be sufficient to maintain the distinction. However, it will be up to the professional judgment of the officers (counselors and placement officers alike) of the System to gauge both intrigue and skepticism so that personal benefit is gained from use but full responsibility for consequences is left with the user.

Preliminary analysis of the rudiments of decision-based action suggests that the routines of the System available for the context of relevance at particular times in vocational development must include:

1. heuristics leading, in potential, to an understanding of the processes of adjustment (Tiedeman and O'Hara, 1963, pp. 43-45); and
2. heuristics leading, in potential, to understanding of the processes of anticipation (Tiedeman and O'Hara, 1963, pp. 38-43).

In addition, the heuristics of anticipation must be focused so as to cultivate understanding of the sub-aspects of:

a. exploration;
b. the future, as seen through the speculations of another;
c. linkages of exploration and supposed possibilities of the future;
d. crystallization;
e. readiness for planning; and
f. readiness for clarification.

The preliminary specification of computer routines for the System (see Appendix B) brought the major problem of decision very much to the fore in my thought. Please reflect upon the above sequence and note that there are essentially only three basic modes which must be represented in heuristic form.

The first of the heuristic modes needed is that of adjustment. In this mode the orientation will be to the past. The restraints will come from decisions already taken. Understanding must come from relation of experience to anticipations of what was expected.

Within the heuristics of anticipations there are two needed modalities. One of the two necessary modalities is that of exploration. In exploration, alternatives will not be available. Hence the machine routines must permit access at random when exploration is the dominant modality.

The second modality within the heuristic of anticipation will have to be that of examination. In many ways, examination will be like adjustment except that personal experience of direct relevance will not be available. In examination, fact, relationships, and complexity as understood by another can serve as a basis for construction of the routines because the alternative can be specified as the user enters this aspect of the System.

There are many gaps in my understanding of the operation of the System which my colleagues and I will have to bridge as the construction of the prototype progresses. However, at the present time the Executive Committee thinks that the fundamental problem of computer programs is manageable in the terms just described. If so, the System problems are essentially those:

1) of providing material appropriate for various levels of consideration;
2) of programming so that material can appear upon command according to the heuristics then considered desirable by the user; and
3) of programming so that the user can benefit from the construction and frequent analysis of the history of his vocational life.

This latter possibility will require the greatest ingenuity and represents my greatest professional challenge.

Goal of the System. I trust it is clear that the System will attempt to encourage an appreciation of the humanistic ethic. The major goal of the System will be to create a developed and potentially available awareness of vocational possibilities in life, vocational competence, in short. Movement toward this goal will be facilitated as appropriate by:

1. attempting to augment the person's awareness of his alternatives at all points of decision;
2. encouraging the person to exercise considered judgment whenever he elects to choose;
3. tutoring the person in the heuristics of choice whenever he enters the System for reason of choice;
4. supervising the person in his practice of some choosing, particularly that associated with his presence in the System but extending beyond limits of the machine aspects of the System to the extent that the necessary financial support is available; and
5. requiring assumption of personal responsibility for the outcomes associated with pursuit of elected alternatives.

Principle Paradigms of the System. The heuristics of the System which have been noted above are applicable in relation to any discontinuity which may be conceived in an anticipatory mode and in which activity is expected to be under direction of thought. These heuristics further presume three paradigms which I discuss here since they will need to give definition both to the manner in which the facts/data are accessible from the computer-based System and to the education of the user as he learns about personal responsibility from analyses of anticipation and adjustment in relation to sequence in discontinuity. The paradigms are:

1. choice;
2. thought in activity; and
3. investment of self in time.

The paradigm of choice will in turn be represented in the heuristics of the System through sub-aspects of:

a. context;
b. proportions of time devoted to contexts;
c. processes in choice; and
d. sequence in choice.

The contexts of choice available in the System will be: 1) educational; 2) Armed Force; 3) occupation; and 4) other.

The paradigm of choice in the proportional-time allocation to context will stress that:

1) responsibility for choice in time allocations can be exercised at numerous times in life; and
2) a person can assume responsibility for some adjustment of time allocations even at the present time (allowing, of course, for variation in available opportunity because of age and sex).

For instance, the System might note for a person that, since he is now age 16, his pattern of time election could well look like this:

Context	Proportion of Time
Armed Force	0
Education	1/2
Work	1/8
Other	3/8

The person might then indicate a choice and find out what the consequent time allocation proved to be. Exploration through numerous alternatives could provide the heuristics for appearance of pattern.

The paradigmatic representation of processes involved in choice must include:

1) investment of time (as above);
2) desired returns;
3) obligations required for receipt of desired returns; and
4) acceptance of delay between investment and return.

Mastery of the processes in choice provides the user with developed capacity for adjusting the proportion of time investment in sequences which can in turn lead to the experience of personal control within life style. The exercise of such control leads to the assumption of responsibility for action in which the person becomes increasingly independent, although also remaining necessarily interdependent. The System will attempt cultivation of this capacity by noting at least three possibilities for personal independence in each of the four contexts in choice. For instance, in the education context, the progress toward independent action (or progression up occupation levels, if you prefer) offered through the heuristics of the System could be to encourage understanding of self in relation to acceptance of:

1) requirements in educational programs (doing what "they" want);
2) choice in electives and individual study (doing what "they" permit me to do independently); and
3) responsibility for consequences when originating ideas (being creative but permitting "them" to criticize my creativity).

Progress possibilities in self understanding for the other three contexts could be:

1) Armed force: a) enlistment; b) some direction of others; and c) command of others
2) Work: both a) change to another company, b) change within the same company; c) change in activity of present job; and a) occupation, b) job, and c) position
3) Other: a) response to required pattern; b) some action upon pattern; and c) assumption of responsibility for setting pattern.

Progress from one independence level to the next in each of the contexts would enhance understanding of self in relation to the assumption of responsibilities during the incorporation of roles, particularly those roles permitting increased personal independence and responsibility. The principle mode of change in levels would still be in terms of proportional time allocations within the four contexts of choice. However, level would introduce an aspect of sequence into the processes of choice.

Before embarking on discussion of the sub-aspects of the paradigm of choice which the heuristics of the System should represent, I noted that thought in activity and investment of self in time were two other primary paradigms which the heuristics of the System had to portray and use. Actually, discussion of the more general conception of "choice" presumes both thought in activity and investment of self in time. However, both are worthy of further direct consideration because each is a central mechanism in the emergence of personal responsibility for career.

The paradigm of thought in activity must be represented throughout the System at three levels. The most general level of representation of thought in activity will be merely to encourage linkage of activity to thought. Think/do associations will be stressed. A secondary manifestation of this paradigm in the System will be to stress education/work associations. This level therefore becomes specific to career development. However, stress of specific levels of thought in activity in the Information System itself can only be conveyed through linking particular educational and vocational facts. The linkages of particular educational and vocational facts therefore constitute a tertiary but ultimate level of the paradigm which will be in the System.

In order to invest self in time, the person must construe the use of time for personal purposes. This stress unavoidably implies that time is of value and is to be valued. Dudley and Fletcher (1965) provide defense of this stress in terms:

1) of the value of entrepreneurial behavior; and
2) of the serious consequences now evident because of a general absence of personal determination in career development through entrepreneurial behavior.

I have since attempted further explication of the concept of time in relation to their general concept of entrepreneurial behavior (Tiedeman, 1965 b).

Development through the System. The paradigms of the prior section will find expression and use in the System through the heuristic modes which provide computer-based access to facts/data in a manner designed to facilitate their transformation into information. Of course, the transformation is a cognitive and experiential process which is occurring throughout life. A System with the flexibility of presenting facts/data of occupations through the outlined paradigms and heuristics can be of great value over a considerable age range. In fact, the range can probably be from kindergarten through retirement if the counselor becomes skilled in judging levels at which users can profitably enter into interaction with the System. These judgments will be akin to those the counselor makes in starting the individual intelligence testing of a person.

However, heuristics and paradigms are not alone sufficient for definition of the System. The development of cognitive capacities and of vocational choice must also be taken into account. Such an accounting is a difficult matter despite valuable leads from Super et al. (1963). Nevertheless, Warren Gribbons (1965) has provided preliminary specifications which will probably find expression in the Information System. The summary of Gribbons' specification is as follows:

> Kindergarten to Grade 3. "The major concerns at this level will be to initiate effective problem-solving behavior, to acquaint the pupils with machines and their uses so they will be able to handle the rather sophisticated materials scheduled for the 4 to 6 grade level, and to initiate broadening of the youngsters' knowledge of the world of occupations.
>
> Grades 4 to 6. "At this point in development, our interest is focused on the youngster's basis for choice rather than on the choice itself. Therefore, during this period of exploration, we wish to have the pupil trust his pre-conscious experiences and give full rein to his imagination as a basis for considering alternatives. We want him to develop only a sense of plan (which presumes a choice) and he may start with fantasy or defense but we would like him to realize [through counseling, if necessary even if by computer (see Cogswell and Estavan, 1965)] when he is considering fantasy, defense, or reality. The emphasis during this period should be on exploratory behavior, which should be flexible. However, our major goal during this period will be to help the youngster to know himself -- his interests, values, abilities -- and to use this knowledge in selecting alternatives. It should then be possible for him to make far better progress through the crystallization and other future stages.
>
> Grades 7 to 9. "The emphasis during this period will be on realistic self-appraisal of abilities, interests, and values and the relation of these to present and future educational and occupational decisions. The student will be getting ready to anticipate and carry out his own plans -- most important of these is his choice of curriculum. The youngster who is successful in self assessment at this level will begin to realize that he is capable of analysis, that he can test out his ideas and that he can develop a capacity to see the consequences of his actions--representing a sense of agency. It will be very important during this period that the youngster not consider his self-assessment a 'test' or a school-type assessment.
>
> Grades 10 to 12. "Particular attention must be given to terminal students who will not have the extra flexibility granted those who will go on to higher education. It is hoped that these youngsters will have developed the ability to make and execute

the plans that will qualify them for the vocations they must now specify, but very careful assessment must be continued so the counselors can identify any areas of weakness and bring them to the youngster's awareness. This, of course, is not meant to suggest that college-bound youngsters be neglected, but only that all young people be given the greatest opportunity to achieve their highest potential whether they have the advantage of higher education or not.

The First Job. "At the present time it seems feasible to expand on the outlined procedures for use by individuals at work, college, or home. The stress should first be placed on planning for stabilization, i.e. becoming qualified for a stable job or accepting the inevitability of instability, and later advancing to the stage of consolidation and advancement.

Post Entry Job. "System should be available for anyone wishing to use it, ideally through touch-tone type approach to be used in the home. The unemployed person or person desiring a change could then insert his private information into the System and request a list of available opportunities at any time. Until this is possible, however, the System might be made available through the neighborhood elementary school. Continued counseling assistance should also be available for those desiring it."

(Gribbons, 1965)

Additional specifications are reported in Appendix C.

Information and Action in Relation to College Placement[3]

The Counselor and the Placement Officer as Supervisors of Action in College. The primary purpose of the proposed Information System for Vocational Decisions is to bring a person at each of the discontinuities of vocational development to a condition of readiness and confidence which is sufficient for him to act on his plan. Therefore, in a real sense the officer in charge of access to the Information System must act toward a user as a supervisor (see Tiedeman, 1965 c) of his turning facts/data into information. This primary charge will ordinarily be the responsibility of a counselor. However, there is no reason why other officers cannot work in close collaboration with the officers of the System with the intention of supervising the person's transition to work or further education. Such officers might discharge the functions now considered to be those of placement officers. But what are the functions of the placement officer, particularly those employed in colleges? Let us turn to this problem now. It is of course the key question in this Conference since it refers to the relation of theory and practice.

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[3] The material of this section is primarily taken from a part of Tiedeman (1965 a).

It can be seen from Gribbons' list of materials and modes of presentation (Appendix C) that the specific set of educational and vocational discontinuities of most direct relevance to career development through college study and work are associated with choosing:

1) a curriculum in high school which qualified entrance into the elected college;
2) at least the college from which the student graduates;
3) a major in college; and
4) an entry job or a graduate school.

In addition, the graduate's experience with regard to educational and vocational discontinuities will include the finer and more numerous differentiations and presumed integrations occasioned by the presentation of content, expectation, and responsibility in the course of education and any previous employment.

Placement of the College Graduate. The placement officer ordinarily manages the transition of the graduate to work. The resources of the placement officer include a set of specific positions which he knows are both open and available to the graduates of his college in a preferential manner. The placement officer performs his job subject to the possibilities that:

1) some graduating seniors may expect placement jobs not listed;
2) not all placed graduates will be satisfied with their placements;
3) not all employers will be satisfied with all graduates the officer helped them secure; and
4) employers who list jobs but fail to recruit satisfactory employees among the graduates may refrain from listing their jobs in the future and some may even make unjustified remarks about the college or the placement officer.

The placement officer ordinarily attempts to share the predicament of his possibilities with the seniors and employers who seek his service. The wish for sharing responsibility for the employment of the graduate gives rise to the conception of readiness for placement now in consideration. Placement officers like students committed to opportunities for which the officer sponsors them. The placement officer's wish to share his predicament with employers gives rise to his interest in the conception of career development. A graduate with "insurance alternatives" or ideas about progress is easier to help if either graduate or company is dissatisfied with the results of a first-job election.

The College Graduate's Readiness for Placement. Ideally, the college graduate who is ready for placement willingly assumes the discontinuity of transition from college to work in awareness of the predicament of the placement office in the terms I have delineated. In relation to his immediate future job his system of thought in action is still in the aspect of anticipation. The basis of his anticipation contains identifiable steps of exploration, crystallization, and choice. The graduate at commencement is about to end the step of clarification with regard to a job he has accepted and will take up tomorrow. Tomorrow, the graduate will pass into the aspect of implementation upon the step of induction. As noted in the introduction, the graduate in this condition can have:

1) a goal;
2) a plan for action;
3) a sense of his own capacity for making the future appear as he wishes it to appear in those ways which are important to him; and
4) a scheme for relating the actual events of the future to his goal and plan in such a way that the information of the future can inform goal and plan and lead to revision or expansion of either or both.

Goal, plan, sense of agency, and feedback mechanism are naturally only in the mind at this time and should not be expected to be permanent although they are frequently compelling bases for action in the immediate future. The graduate's immediate goal is likely to be more permanent and even more compelling:

1) if the system of justification offered for it relates the experience of implementation of previous educational decisions of vocational significance to the present plan; and
2) if the present plan looks to the future in a way such that tomorrow's job is a part of a larger plan for personal development through career development

This judgment is offered on the supposition that integration occurred in relation to the prior discontinuities of vocational relevance and that at least the step of exploration is in mind in relation to the job on which the present one is predicated.

I find it useful to think of this ideal as I reflect upon the interest of the placement officer in the college. The ideal immediately suggests the following conditions which the placement officer longs to see fulfilled:

1) potential graduates have been contacted sufficiently far in advance so that thought in action with regard to job election has opportunity for occurrence;
2) job election is a part of the continuity of choice of study;
3) job election honors the possible in terms of accepting a) the referrals available from the office if satisfactory or b) the small resource available to the office for turning up, when necessary, desired but not available, jobs; and
4) job election occurs a) upon investigation of several alterna-

tives and b) upon consideration of longer term, as well as immediate, possibilities.

Career Development through College Study and Work Although the placement officer justifiably works to attain the conditions of placement readiness as idealized, the college graduate is not likely to accept the predicament of aided placement which I have delineated unless he is also acquiring an emerging comprehension of the process of personally determining his career I have already indicated that comprehension of the process is a psycho-social matter of long term. The process also requires further cultivation throughout college because it is here that the conscious stirrings of identity can be brought to conceptualization of the personally-determined career Unfortunately, the college student is usually not liberated with regard to informed personal determination. (The student so frequently encounters those who know and do what is best for him and so infrequently those who offer him responsibility for his own action!) Such a condition is an anomaly for the liberal arts college in particular because the personally-determined career is the essence of liberation through education. And yet the anomaly does turn up rather frequently even in liberal arts graduates.

The college frequently fails to create students competent in securing personally-determined careers because there is an unfortunate withdrawal in colleges from responsibility for providing supervised experience for students. The cultivation of thought in action requires experience and the analysis of experience as well as lectures about experience. The analysis of experience provides the circumstance in which it is possible to realize the importance of conceptions as well as to experience competence and thereby to gain confidence in the application of concepts. Relevant experience is vitally necessary in order to create a context in which students can relate the conceptions of the alleged disciplines to the requirements of action in social context. Vocational-technical schools which do not mimic colleges enjoy greater opportunity for helping students to confidence in competence through supervised experience (Tiedeman, 1965 c). A vocation practiced in commitment but espoused with tentativeness represents the essence of liberation (Morley and Tiedeman, 1965). Freedom through a proper kind of vocational competence! There is my challenge to colleges which ignore the vocational during education.

I acknowledge that I overstate my indictment of the college. However, as a college permits professors to withdraw from the presentation of conceptions in living, the education of that college may well be considered more liberal but it actually becomes less liberating. Percepts without concepts may well be blind but concepts without percepts are indeed empty.

Such circumstances ordinarily disenchant those of us involved professionally in placement in the college. Many professors are so enamored of the restraints which they place upon their lectures that they tend to isolate themselves from the emotions of their students involved in the assimilation of the professor's ideas. And yet it is largely through the emotions that assimilation is turned from a reproductive to a generative character. In other words, it is primarily through the emotions that the discontinuity of the professor's restraints is generatively assimilated into the student's continuities Although those in placement work may strive to introduce programs of activities into colleges and although they may strive to place the students in a condition of anticipation with regard to immediate and later employment, efforts will not bear abundant fruit in an emotional desert among the faculty.

The personally-determined career is a time-extended organization of thought in action which is accompanied by satisfying and satisfactory experience. Career development through college study and work, as we wish to cultivate that development, requires continual intensification of the impression of self in experience. Student personnel workers seek to cultivate this impression through a program of guidance-in-education (Tiedeman and Field, 1962 and Tiedeman, 1965 d) which is practiced throughout education in all of its levels. The task of placement of the college graduate is easier and more satisfying to the placement officer when students have experienced this cultivation over an extended period, as they could with the availability of an Information System for Vocational Decisions. However, the placement officer need not despair in the absence of a student's prior interaction with an Information System of the kind I describe. There is no more precious gift than the presence of self in intelligence. Seek to bestow this gift upon whomever you can, whenever you can, whatever the student's present condition of readiness!

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Appendix A

UNDERSTANDINGS NEEDED FOR PREVENTION OF CLAIM THAT SYSTEM DETERMINES LIVES

I. Limits on counselor

  A. Only places person in a condition of readiness for entry into discontinuity

  B. Uses personal history in prior discontinuities to bring about readiness as in A.

  C. Recommends about curriculum in order to help in A.

  D. But does not progress with the person into the next discontinuity

II. Limits on System

  A. System provides only facts/data

  B. Facts/data must be as accurate as possible

  C. Facts/data must be up-dated as much as possible

  D. Projections of future must be entered and used in responsible ways

  E. Bases for facts/data and projections must be transmitted as feasible

  F. Applications transmitted by the System for the person must be in good taste and responsive to the wishes of both parties involved

  G. Personal data must be kept confidential

  H. Personal data must be de-personalized when later used in improving the System

I. Only the person is responsible for goals, plans, and clarifications achieved through System no matter what the heuristics may be which the System created for the person

Appendix B

PRELIMINARY SPECIFICATIONS FOR DATA AND ROUTINES

I. Provide material for each of four contexts - education, armed service, occupation, other

II. Provide grades of specificity and reality in each context

  A. Perspective (visual with auditory but arranged in panoramic perspective, i.e. show a whole manufacturing process, a whole military operation)

  B. Specific

    1. Provide for focus upon elements upon demand from person (still visual with auditory but arranged so specific emerges as foreground from background of perspective)

    2. Provide for presentation of occupational information (somewhat in the style of the Occupational Outlook Handbook)

    3. Provide for simulation

      a. Note needed decisions

      b. Invite play against machine, e.g.

        1. Selling (what's it like to miss a sale nine times in a row)

        2. Managing a company (provide difficulties in having authority and responsibility)

      c. Have machine always explain bases of its wins - (If you wanted ____, you should have done ____.)

4. Visits for observation with discussion (i.e. get the feel of the people at work)
5. Supervised practice - analysis, criticism, and revision of the practice of being intentional
6. Supervision of revisions of patterning of time use in life styles

III. Routines required for the computer - provision of heuristics for the mastery of purpose in action through repeated analyses of personal history and present desires

A. Heuristics for analysis of the aspect of adjustment (Tiedeman and O'Hara, 1963, pp. 43-45)

1. Encourage person to create an account of his experience with his most recent discontinuity in terms remembered as expected prior to entry upon the discontinuity - memories of prior anticipation
2. Review account in 1 and query to ascertain person's identification of steps of
    a. Induction
    b. Reformation
    c. Integration

    (See Tiedeman and O'Hara, 1963. Program should largely probe for attitude toward the pursuit of intent in the social context met in the experience of the discontinuity)
3. Call up previous record of anticipation of the discontinuity

4. Encourage comparison of 1 and 3 for identification of differences
5. Query with regard to differences to create heuristics for elaboration of the bases of differences
6. Elicit statements of opinion about one's person in terms of abilities, interests, and values given 5.
7. Call up previously stored objective observations in terms of abilities, interests, and values
8. Compare 6 and 7 (e.g. O'Hara's self concept indexes) for identification of possible differences
9. Query with regard to differences offering the person the option of calling for new testing of himself in order to determine if he _has_ changed the previously stored objective conditions
10. Repeat 1-9 for next earlier discontinuity than one now in consideration and hence being entered into record
11. Repeat 10 for other previous discontinuities if desirable and possible
12. With 10 and 11 encourage person to prepare an up-dated statement of his life context
13. The emergence of higher order conceptions which have consistency with prior specifics but offer alternatives not previously available constitutes the structure (Bruner, 1962) of the personal history. This structure constitutes

the self-concept system in relation to the person's exercise of intent. [Refer to list of Super's self-concept system variables (Super, et al., 1963) for suggestion of some of the terms in which this structure can be discussed in assessment, personal or otherwise.]

14. Store new statement of personal structure

B. Heuristics for analysis of the aspect of anticipation (Tiedeman and O'Hara, 1963, pp. 38-43)
   1. Heuristics for exploration - learning how one translates think/do (i.e. the widening of one's awareness of his preconscious experience and processes)
      a. Primary terms
         1) Abilities - what I can do
         2) Interests - what I like to do
         3) Values - what I will do
         4) Future - what others presently think it will be like at specified times ahead
      b. Heuristics for future
         1) Primary terms will have to be concepts and ideas
         2) Heuristics will emphasize the invention of uses for ideas (i.e. the program will need to be one of translation)
         3) Uses offer alternatives
         4) Alternatives permit some specification of consequences

   5) Consequences permit some specification of potential barriers
   6) Potential barriers permit estimation of economic and personal cost
   7) 1-6 permit anticipation of what is likely to occur and what will be required to make it occur
   8) Suggest selection of duties for one's self in relation to 7
   9) Suggest translation of possible future duties as in 8 to today's alternatives (we will need to provide the language and translation for linking education, work, and armed service through education and development)

c. Heuristics for linking future and abilities, interest, and values
   1) Translate abilities, interests, and values into present alternatives after review of personal history
   2) Encourage statements of linkages of think/do
   3) Highlight awareness of personal investments of time
   4) Attempt widening of areas of personal activity
   5) Attempt linkages of opportunities to actions given abilities, interests, and values

   [Refer to list of Jordaan's exploration variables (Super, et al., 1963) for suggestions of some of the terms in which exploration can be discussed in assessment, personal or otherwise]

2. Crystallization (e.g. a step in making pre-conscious become conscious)
    a. Suggest alternatives
    b. Encourage personal imposition of ordination upon alternatives as provided and as personally augmented
    c. Encourage realization of exclusions
    d. Encourage realization of bases for exclusions
3. Readiness for planning (i.e. making intentions efficient)
    a. Start with chosen activities
    b. Test for relevant facts
    c. Supply missing facts
    d. Provide for review of choices (i.e. for return to programs B.1 and/or B.2 and/or B.3)
4. Readiness for clarification
    a. Seek listing of needed next activities
    b. Promote the sequencing of activities
    c. Prompt to evolution of evaluation system (i.e. for listing of contingencies and for means of assessing in order to choose as contingencies become definite)
    d. Encourage linking of assessment in contingencies to potential revisions of goals and/or means of attempting to secure goals

Appendix C

PROCEDURES FOR IMPLEMENTING THE MAKING OF VOCATIONAL DECISIONS

(Adapted from Notes of 8/20/65 & 8/24/65)

Warren D. Gribbons
Regis College

The procedures should reflect the facts that vocational development takes place within physical, educational, and occupational frames. Therefore, the materials should provide for distinctions in at least the following levels of the educational frame (other frames are generally coordinate in development with the educational and may therefore prove unnecessary):

1. Kindergarten through Grade 3
2. Grade 4 through Grade 6
3. Grade 7 through Grade 9
4. Grade 10 through Grade 12
5. Grade 13 and Grade 14
6. Grade 15 and Grade 16
7. Grade 17
8. Grade 18 and beyond

At the present time, specifications are not complete for any level nor inclusive of all levels.

The specification of needed procedures are organized according to the above levels within the following categories:

Part A - Responsibilities of Teachers

I. Cultivation of machine use, problem-solving mode, and knowledge of possibilities for influence of restraints on personal desires

Part B - Responsibilities of Counselors

II. Cultivation of personal responsibility - the emergence of self

III. The influence of the past on the future - aptitudes, accomplishments, interests and values in relation to educational and vocational choices

IV. Choice, clarification, accommodation, and progress in educational frames

V. Exploration, choice, clarification, accommodation, and progress in relation to work frames

Part A - Responsibilities of Teachers

SECTION I. CULTIVATION OF MACHINE USE, PROBLEM-SOLVING MODE, AND KNOWLEDGE OF POSSIBILITIES FOR INFLUENCE OF RESTRAINTS ON PERSONAL DESIRES

Kindergarten - Grade 3

A. Introduce machines and instruct in their use

1. Begin with simple familiar machines--dials, typewriters, etc., and advance to more complex, productive machines

2. Refer to Section V, Kindergarten - Grade 3

B. Initiate rudimentary problem-solving behavior

1. Game approach similar to that used for reading readiness, e.g. large board with picture problem (probably showing person at work)--respond to questions: What? Where? How? Why?

2. Emphasize use of questions:
"Why do I?" "How did I?" How could I?"

3. Toward end of third grade initiate "case method" closely tied to youngster's own needs
e.g. "Peter faced with studying lessons or going out to play," should encourage youngsters to consider many factors before making decisions

Grades 4 - 6

A. Continue instruction in problem solving with special emphasis on school, home, neighborhood

1. Present additional case studies to increase awareness of factors to consider in making decisions; with particular attention to alternatives influenced by different abilities, interests, and values

2. Pre-You: Today and Tomorrow-type book
Know self-abilities, interests, values
Intellectual and emotional involvement with personal-social materials

B. Also refer to Section V, Grades 4 - 6

Grades 7 - 9

A. Continue instruction in problem solving

1. Broaden to state, national problems
e.g. political, conservation, etc.

Grades 10 - 12

A. Curriculum Implications

1. Special emphasis on personal development in e.g. civics or economics courses

a. Changes can be obtained through personal action

b. Changes can be obtained by changing laws--minimum wages, hours per day and per week, etc.
Difficult especially with lower socio-economic groups, but may be possible through involvement in "doing," i.e. personal visits to legislature, etc.

Part B - Responsibilities of Counselors

SECTION II. CULTIVATION OF PERSONAL RESPONSIBILITY - THE EMERGENCE OF SELF

Kindergarten - Grade 3

A. Instruction and supervision in "How to Study"

Grades 4 - 6

A. Cultivate me-they relationship

1. Show how people affect one another
   I affect you.
   You affect me.
   We affect them.
   They affect us.....and all of these relationships
   affect our decisions.

Grades 7 - 9

A. Awareness of think-act dichotomy --- Continue "Know Self"

1. You: Today and Tomorrow-type book

2. Readiness for Vocational Planning-type instrument for computer (see Cogswell and Estavan, 1965)

3. Self Concept Index for computer use

B. Emotional involvement plus intellectual involvement

1. Counselor must be available to help clarify youngster's understanding of facts/data so he can transform them into information

2. Counselor must be available to assist youngster through traumatic emotional experiences when and if they occur. Machine might inform: "Medical doctors usually hover in the first quartile scholastically." I want to be a doctor but I am in the third quartile. I may even have trouble getting into college, and my father wants me to go to his school.

C. Encourage taking of personal responsibility for choices

1. You: Today and Tomorrow-type book

Part B - Responsibilities of Counselors

SECTION III. THE INFLUENCE OF THE PAST ON THE FUTURE - APTITUDES, ACCOMPLISHMENTS, INTERESTS, AND VALUES IN RELATION TO EDUCATIONAL AND VOCATIONAL CHOICES

Kindergarten - Grade 3

A. Create records for individual use in future feedback

1. Test data
2. Educational and vocational interests and aspirations

Grades 4 - 6

A. Continue testing program and add to private records

1. Use Readiness for Vocational Planning-type procedure with its possibility for instant feedback--adapted for machine use (see Cogswell and Estavan, 1965)
2. Counselor assessment - possibly through counselor's monitoring 20-30 consoles and then informing youngster (through machine system) of factors he is failing to consider in making decisions

Grades 7 - 9

A. Continue testing program and add to private records for feedback

Grades 10 - 12

A. Continue testing program and increase ability to use resources

1. Add to private and public records (U.S. Employment Service Test, etc.)
2. Encourage realistic appraisal of test scores
3. Develop awareness of present-future relationship
4. Provide opportunities for youngster to review all data in his "private bank"

B. Continue to stress realistic appraisal of abilities, interests, and values; and need to take personal responsibility for choices

Part B - Responsibilities of Counselors

SECTION IV. CHOICE, CLARIFICATION, ACCOMMODATION, AND PROGRESS IN EDUCATIONAL FRAMES

Grades 7 - 9

A. Concentrated instruction on curriculum choices--EARLY!

1. Thorough acquaintance with curricula available
    a. Relationship of subjects/curriculum to occupations and future education (see Cogswell and Estavan, 1965)
    b. Requirements for success in various curricula
2. "Off to School" Off to Work" -- movies, cartoons, booklets

Grades 10 - 12

A. Development of college-orientation

1. Bring to awareness need to specify college preference
2. Information on how to obtain entrance to college
    a. Early plans for CEEB's
    b. Machine to match private data with bank of data available on colleges; i.e. match capacities and needs of student to requirements and offerings of specific schools
3. Information on great range of different types of schools, e.g. Jr. Colleges, Four year schools, etc., but also specific information on many schools of type finally selected--not limited to either local or distant schools
4. Provide link for self responsibility in study
    a. College-type lecture course with particular attention to note taking
    b. Responsibility in doing assignments--chapter assignments to be completed on schedule

Grades 13 - 14

A. Development of college-orientation

1. Provide intense period of self exploration with emphasis on linkage of study to future world of work

    a. Relate abilities, interests, values, and hoped for style of life to occupations open to graduates of different courses and programs. Consider the future.

2. Emphasize need to compromise in decision making, i.e. awareness of risks, rewards of involvement in moving toward ideas, which is implicit in the change

3. Involve students with machine system for choice of job following graduation

4. See Section V., Post High School and College, A. Progression in Work-Orientation

Part B - Responsibilities of Counselors

SECTION V. EXPLORATION, CHOICE, CLARIFICATION, ACCOMMODATION, AND PROGRESS IN RELATION TO WORK FRAMES

Kindergarten - Grade 3

A. Bring within child's awareness the kinds of jobs in his neighborhood, and then expand horizon beyond those with whom he comes in direct contact

  1. Game approach
     Pupils and/or teacher suggest occupation for game, and all contribute as much information as they have about it. When this source of information is exhausted, teacher (later pupils) will go to machine and plug in for film strip, movie, etc., which will be prepared specifically for a particular age group.

Grades 4 - 6

A. Broaden occupational frame of reference

  1. Introduce new occupations to excite imagination and broaden vista using real and fictional heroes. Fantasy may be involved, but there should be some rudimentary link to reality.

     a. Use "live models" through film strips and tape recordings. Model will describe job, how and why he chose it, requirements for job (educational, physical, special aptitudes, etc.), why he likes the job, and any special satisfactions he achieves. In addition, his spare-time activities and home should be described or shown. (also cartoons, pamphlets)

  2. Emphasize time, distance, compromise, money, and planning involved in achieving goals

  3. Illustrate impact of job preference to "style of life" (see 1-a above)

  4. Stress relationship of school subjects to specific occupations with special instruction on available curricula.

B. Provide facts/data on preparation for neighborhood jobs (use familiar to stress preparation, delay to get)

C. Encourage process of crystallization

1. Face-to-face conferences with counselor who could help youngsters become aware of alternatives, consequences of his acts (to the extent that he has failed to gain this information through use of machine or has failed to interpret the data properly)

Grades 7 - 9

A. Occupational facts/data

1. Emphasize future projected manpower needs and occupational patterns

    a. e.g. skilled trades will diminish with automation

2. Reports of recent graduates--heroes and drop-outs (on tape, personal appearances)

3. How to get work

Grades 10 - 12

A. Occupational facts/data

1. Move from general to specific plans

    a. Bring awareness of need to specify vocational preferences

    b. Stress timing, responsibility, and urgency

2. Detailed, specific instruction

    a. How to obtain entry job

    b. How to apply to college

B. Development of work-orientation

1. Move from general to specific plans

    a. Bring awareness of need to specify vocational preference. Stress timing, responsibility, and urgency

    b. Information on how to obtain entry job

   c. Provide linkage of educational background to work qualifications. "On basis of past history, what am I qualified for?"

   d. Input of "Help Wanted" advertisements into system--translate possibilities to immediate opportunities for self

   e. Inform about relationship to fellow workers as well as superiors

Post High School and College

A. Progression in work-orientation

   1. Securing entry job

      a. Opportunity to check private information against public information to alert to:

         1) Opportunities open to person with his qualifications

         2) Possibilities for advancement, projected salaries, "style of life" in specific occupations

         3) Possibility for person to release resumé if he wishes

   2. Crystallize transformation from occupation to job, and later to position

      a. Person must take responsibility for moving in direction of position (sense of agency)

      b. Assemble records of past achievements and realize there is freedom of choice

      c. Person must realize crucial link is promotion and he has freedom to determine this for himself

         1) Promotion within same company in same type of work

         2) Change type of work within same company or with other company, possibly involving change in level

         3) Promotion through movement of location

3. Continue Readiness for Vocational Planning-type self-assessment

4. Use technique of simulation to help experience change and new affiliations. E.G., movies showing different levels of responsibilities and the accompanying need for decision making and stress that will occur

5. Make person aware that at least two types of stress will occur

   a. Stress on himself through self-understanding

   b. Stress from society through responsibility

6. Make person aware of contingencies involved in change

   a. Possible sacrifices involved in choice
      risks, sorrows, joys involved in change
      e.g. change in level may bring higher salary,
         but less leisure time to enjoy material
         advantages of greater income

INFORMATION SYSTEM for VOCATIONAL DECISIONS.
MISCELLANEOUS PROJECT REPORTS

The work of the Information System for Vocational Decisions is supported by grant no. 1-061819-2240 from the U.S Office of Education, Department of Health, Education, and Welfare.

Graduate School of Education
Harvard University

1968

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INFORMATION SYSTEM FOR VOCATIONAL DECISIONS,

Project Report No. 2

(2)

AN INFORMATION SYSTEM FOR VOCATIONAL DECISIONS (ISVD): CULTIVATING THE POSSIBILITY FOR CAREER THROUGH OPERATIONS.

David V. Tiedeman

This paper was supported in part by Grant No. OEG-1-6-061819-2240
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Graduate School of Education,
Harvard University Cambridge, Mass,

December, 1966

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AN INFORMATION SYSTEM FOR VOCATIONAL DECISIONS (ISVD):
CULTIVATING THE POSSIBILITY FOR CAREER THROUGH OPERATIONS[1]

David V. Tiedeman
Graduate School of Education
Harvard University

I. Thesis

(The acquisition of the vocational role in life can be considerably improved by further incorporating vocational education and development into liberal education.)

II. Background

A. Ashcraft - the case for career, in addition to the case for occupation.

B. Crites - delineated vocational maturation as it is, not as it might be.

C. ISVD - represents deliberate effort to cultivate vocational maturation; i.e., to make maturation occur.

III. The System

A. General framework

B. Data bases

C. Decision-making: the paradigm for choosing

D. Computer routines

E. Materials

F. Career: the maturation of personal responsibility through vocational development

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[1] Outline of paper read at Panel, "Significant Research Findings from Section 4(c) Projects" during the Annual Meeting, American Vocational Association, Denver, Colorado, 7 December 1966. Robert P. O'Hara is Executive Director of the System. Principal Investigators are Russell G. Davis, Allan B. Ellis, Wallace Fletcher, Edward Landy, David V. Tiedeman, and Michael J. Wilson.

AN INFORMATION SYSTEM FOR VOCATIONAL DECISIONS (ISVD): CULTIVATING THE POSSIBILITY FOR CAREER THROUGH OPERATIONS[1]

David V. Tiedeman
Graduate School of Education
Harvard University

Thesis

You vocational educators are indeed kind to let me join into your interests and work through my research. I congratulate you and the U. S. Office of Education who, through leaders such as Louis Bright, Alice Scates, David Bushnell, and Richard Otte, have in recent years brought the important and delicate matter of vocational education under more intense research consideration in order that the acquisition of the vocational role in life can be further improved.

I am grateful that I can participate through research at Harvard University in your aspirations for vocational education. I trust that Harvard University can both lend perspective to our common concerns in vocational education and attest to the importance of the enterprise itself. I also hope through my work under Section 4(c) of the Vocational Education Act of 1963 to underscore realization that the completion of vocational development is one of the ultimate liberalizing and humanizing experiences.

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[1] Paper read at Panel, "Significant Research Findings from Section 4(c) Projects" during the Annual Meeting, American Vocational Association, Denver, Colorado, 7 December 1966. Robert P. O'Hara is Executive Director of the System. Principal Investigators are Russell G. Davis, Allan B. Ellis, Wallace Fletcher, Edward Landy, David V.Tiedeman, and Michael J. Wilson.

I believe that vocational education is necessary in liberal education in order to cultivate completion of vocational development more avidly than now occurs. This is the thesis I shall develop further with you in my several minutes. I trust that I can appropriately convey my actual belief that clear understanding of the necessity and import of the vocational role in life constitutes a freeing, not a constraining experience. I say this because, in the course of my talk, it may surprise you to learn that I will attempt to use a computer-based Information System for Vocational Decisions to further vocational development. Despite public opinion that computers make decisions and thereby determine lives, I intend to assemble a System in which users can, and must, themselves make decisions and thereby experience both much widened opportunity and the expectation that they will become more capable and responsible for determining their own vocational destinies.

Background

Ashcraft related the concepts of career development and curriculum. He spoke of the facilitation of career development through general and vocational education. Ashcraft argued that occupation is a specific, not final nor full, experience within the career. This condition cannot be achieved within just the necessary limits of vocational education. Vocational education presently largely limits itself merely to the provision of skill in relation to a specific occupation. Commitment, albeit temporary I hope, is absolutely necessary for skillful practice of an occupation. However, in order for career development to proceed, it is necessary both that the commitment to occupation first exist and that the decision about specific occupation later diffuse into a condition of tentativeness. Vocational education does not at the present time sufficiently modulate its emphasis on commitment by a simultaneous emphasis on tentativeness. This is a condition which the Information System for Vocational Decisions expects to alleviate in important ways. The aim of the System is to foster capacity for, and confidence in, career, not just occupation.

Crites outlined the process of vocational development as he presently knows it to exist. Crites noted that vocational development occurs throughout several years of life. Furthermore, vocational development has several identifiable modes and processes of expression. These modes and processes of expression largely develop in relation to the tasks and choices of an educational and vocational nature which we make it possible for youth and young adults to experience.

Since Crites is studying vocational development as it exists, he deliberately avoids considering how it might be. The Information System for Vocational Decisions which I and my colleagues are assembling in prototypic form, will do the contrary, namely focus on vocational development as it might well be. In doing so, we will attempt to take advantage of Crites' studies of what vocational development now is and to cultivate the career concept which Ashcraft sketched. However, the specific dimensions of vocational development which we will be attempting to augment are:

1. the placing of occupation into vocational development

as but a single instance of vocational expression;

2. the offering of responsibility to students and workers for choice in education, work, leisure, and marriage;
3. the extension of opportunity for occupational choice and preparation down into the elementary grades and out into work until retirement; and
4. the provision of an explicit educational context within which students and workers can be made aware of the value of fantasy, imagination, and preconscious experience for maintaining some continuity in personality organization and career while permitting the incorporation into personality and career of discontinuity in educational and occupational opportunities.

The faith of the System will be that intuition disciplined by reason offers the chief "guiding" mechanism for us in our democracy.

The System

General Framework

The Information System for Vocational Decisions is deliberately named despite the fact that our connotations for its words are not presently entirely a matter of common parlance. The word "Information" is intended to connote the placing of facts/data into the context of use. This use of the word emphasizes our belief that facts/data require the context of use if they are to be conceived as information.

Students and workers are to be permitted to turn educational and occupational facts/data into information through the System. Thus the user becomes an explicit part of our connotation of "System." Our connotation reflects our intention to offer the user complete responsibility in choice of educational and vocational goals. Although it is probably inevitable that the computer will be blamed for "error," we do not intend to let the users of our System enjoy the luxury of that impression without contest.

The possibility for user determination of data processing in the System will be provided by a time-shared (or time-sliced as some prefer) computer potential. User-computer interaction becomes possible in the time-shared mode of modern large-scale computers. In that time-shared mode, the user 1) can make direct input into the computer under guidance from its predetermined routines, 2) can direct the processing of this input and other stored facts/ data, and 3) can determine somewhat the form and content of the output. As you know, the speed of modern computers makes all this possible as if there were no delay in the computer's access to the user. Actually there is delay but the trick in establishing the operating computer programs governing the System will be to minimize that delay for the several users who will be in interaction with the computer seemingly as if their interactions were simultaneous. To the extent that delay becomes a factor in our System, the System will not service the needs of the user when he is exploring. For exploration, the mood being simulated in the interaction must be that of browsing. For instance, we all know that the telephone line has to be without "busy" signal when we are calling a person while in a condition of doubt about necessity for our calling.

Our context for generation of information through user-computer interactions will be that of vocational decision. Vocational decisions require parcelling of time and effort by the user to the several areas of his living in which attention and activity are expected. Our System will foster thought in relation to time and effort allocation to four areas of living: education, occupation, military service, and family. These categories represent several important elements of society in which interdependent activity is expected. Our System will deliberately emphasize the necessity for interdependence, but through encouragement of the expression of independence. We hope thereby to help persons mature through the exercise of choice and the mastery of choice processes, but to find self expression within responsibility for societal condition.

Data Bases

The System will have a data base for each of four areas of living: occupation, education, military service, and family. Data in each base are to range from general to specific. In addition, data will attempt both schematically to represent the present and to outline the future for a decade or so, such outlining to be in small time increments. These specifications obligate the System both to deal with local job markets and to incorporate data on local job vacancies which will be helpful in placement suggestions. The specifications further obligate the System to deal with education in generality sufficient for liberal education and in specificity sufficient for both local use and immediate progress to the next level in a sequence of subjects or to activity of laboratory, practice, or actual kinds.

The fifth data base in the System will contain student characteristics. This base will be in two parts. One part will deal with characteristics of students in general and will report on relationships of these characteristics with later choices and successes of those students. This base will be used both to suggest alternatives to users who need wider scope for consideration and to subject aspiration to the test of "reality" when the user is in a condition of clarification of a preferred alternative. The other part of the student characteristic data base will be the private educational and occupational history of the user as portrayed in his context of developing justification for his preferences and their pursuit and consequences.

Decision-making: The Paradigm for Choosing

Reflection upon the facts/data of the data bases under System expectation that facts/data will be used will be offered in a paradigm of vocational decision-making which I have fashioned with Robert O'Hara. The paradigm essentially conceives decision in relation 1) to the passage of time, and 2) to the undertaking of activity required to achieve what one elects to achieve. This conception permits division of the time interval into a period of anticipation and a period of accommodation. Anticipation occurs before the activities of a discontinuity become required; accommodation occurs after activity is required. Stages of exploration, crystallization, choice, and clarification are distinguished within the period of anticipation. Stages of induction, reformation, and integration become possible within the period of accommodation. Distinctions among these stages will have to be a central part of the Monitor computer routine which I describe in the next subsection.

Computer Routines[1]

Computer routines and supporting materials will be fashioned to conform with expectation that this vocational decision paradigm both exists and can become explicit and useful to someone who practices its use. The paradigm will determine the computer routines which we will develop to permit access to each of the data bases and to provide data upon request. There will be three primary computer routines: REVIEW, EXPLORATION, and CLARIFICATION.

The REVIEW computer routine will permit call up and comparison of a prior statement about a then future event after both that expected future event has occurred and the user has provided indication of how his prior expectations were fulfilled before he sees his prior statement of those expectations. The procedure will expect a person to experience insight with regard to consistency, and inconsistency available during comparison, and to learn from such insight that his own intuition guides his activity. The intended outcome of REVIEW is that the user learn from his history.

The EXPLORATION computer routine will allow the person to rove through a data base as near randomly as possible. The routine will encourage use of randomness largely at general levels to conserve time but will not forbid specific exploration when desired. Furthermore, routines will be developed to suggest alternatives on the basis of comparison of personal characteristics with established associations between such characteristics of others and their preferred alternatives. The intended outcome from this routine is 1) emergence of a set of alternatives, and 2) the bases on which the alternatives are preferred. We emphasize this latter point to increase awareness of the reasoning process that is actually involved in career development.

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[1] The basis for this planned use is due to Allan B. Ellis.

The CLARIFICATION computer routine will be available after specific alternatives are selected. CLARIFICATION will take the user into queries about the depth of his knowledge concerning the then favored alternatives and the understanding of future alternatives which are likely linked with present preferences. The outcome desired from CLARIFICATION will be the disspelling both of some doubt and of some ignorance concerning the next step in the progress of career which the person is evolving. Lessening of both doubt and ignorance is likely to increase the user's confidence in meeting the required activities of his next step.

In addition to the three primary computer routines, MONITOR will be available as the only secondary computer routine. MONITOR will essentially consist of the evaluations which we are able to concoct to determine existence of mastery of stages in the paradigm of vocational decision-making. For this reason, MONITOR must be able to play back into as well as over the computer inputs which the person generates. There will be three essential aspects of MONITOR. The first aspect will be the actual MONITOR procedure which we concoct and program the computer to provide. The second aspect will be the bases on which we have caused our judgments to operate among the data put in by the person during his interaction with the computer. The third aspect will be the basic computer routines themselves which the person will be taught to use if and when he desires to have them. This aspect will make it possible for the user to write his own monitoring bases to some extent and to have these monitoring procedures play among his material just as ours did originally. We hope through MONITOR to encourage mastery of the concept of feedback and to give practice and supervision in its application.

Materials

The computer routines will incorporate the vocational decision-making paradigm. We do not expect that the computer will itself be sufficient to mature fully the capacity and confidence for use of the decision-making paradigm. We will therefore design two other activities into the System. One of these activities will be the simulation of decision-making. Simulation will be available in 1) games, 2) booklets in which the concepts are taught, and 3) decision problems of a vocational nature which must be solved in interaction with the computer.

The second of our activities which we hope will further mature the use of the paradigm of vocational decision-making will be the actual provision of responsibility for work under laboratory and practice conditions. In laboratory and practice, reality can replace imagination if there is intentful supervision of our users as they practice. This supervision will probably be of the same nature as that employed by counselors with our users as they are engaged in the simulated activities of vocational decision-making during user-computer interactions.

Our materials must be compatible with computer use and must contribute to education for vocational decision-making. We will attempt to make visual and typewritten inputs available to our users under direction from the computer. Oral input must be with either the direct aid of the counselor or after his later review of a tape recorder. On line,oral input is not yet available in modern computers.

We will attempt to make pictorial and word outputs available to our users as well as auditory outputs. The coordination of our input and output modes with the several modes of the decision-making paradigm will test our imaginations to the limits.

Career: The Maturation of Personal Responsibility through Vocational Development

I have so far attempted to show that the Information System for Vocational Decisions will expect choice and will cultivate the capacity for and confidence in choosing by giving users almost infinite possibility for the exercise of decision-making among data bases while simultaneously attempting to make the processes of decision-making both explicit and mastered. These are elements in vocational development which have previously neither been unified in this manner nor made available for practice in modes in which complexity is possible but time is not of the essence, at least not the time of persons other than the person engaged in the exercise. The existence of the System will therefore be a first-time physical representation of the "outside" which the person must first learn to bring "inside" and then to act toward knowing that it is there but knowing that he need not be "driven" by it if he is the master of it.

In its totality the System will represent "reality" in its data bases, offer processes for working with facts/data through its primary computer routines, and provide practice for integration of a differentiated condition. The System will provide practice under supervision through 1) its secondary computer routines, 2) its simulation of decision-making, and 3) its personal supervision a) by a counselor of the person in interaction in the computer routine and b) by a vocational educator as the student user assumes real work responsibility in laboratory and practice work situations.

The person who through his life comes to master structure and process in this way and to come to a comfortable and integrated accommodation to both, has mastered the archetectonics of vocational development. He has both developed and been tutored in the capacity to consider his development and to engage in the thoughtful activity which puts the person into development. This is possible through vocational development in which the "myths" of "others" and "authorities" are available in machines but interactions with their pronouncements are encouraged in ways in which all are eventually disclosed as being only partial and never completely accurate. By offering the person opportunity to come in contact with the best of the known and to grow in realization that the best of the known is still not Truth, it becomes gradually possible for him to realize his own possibilities and responsibilities in representing his desires and aspirations. Through the practice of aspiring in the System, the user first has a "crutch" for the expression and testing of aspiration. It remains for the supervisors of the System to make sure that the "crutch" is later abandoned but that return for data/ facts is not denied when they can usefully contribute to later decisions.

I speak of a mature condition in vocational development which is only approximated, never fully attained in all regards with all decisions. However, through patience and practice, persons should be able to achieve more mastery of the processes required for thought in action than is presently the case.

Processes of thought in action mature slowly. This is why the System expects to span a range from elementary school to retirement.

Processes of thought in action require practice and feedback as well as the exercise of imagination. This is why the System starts in imagination but spans reality through simulation of reality and through supervision of activity in real condition.

You vocational educators have to recognize in your daily activities the need for reality as test for imagination. This is an important reason why the Information System must embrace vocational education. Since vocational education is a form of education in which reality enters into education, I personally think it is a shame to attempt to make vocational education more general. Instead, we should attempt to make vocational education more specific to the goal of role incorporation. The vocationalization of preference and activity depends as much, if not more, on education for understanding of choosing and role acquisition as it does on training for occupational skills. Vocational educators would therefore do well first to insure that their colleagues in general education did not forget to train for relevant occupational skills through their "general" curriculum, and second to concentrate their own attention on the socialization processes which are involved in developing understanding in relation to the processes of choosing and role acquisition. Such priorities would 1) place a general goal into the specific interests of vocational educators, 2) make both general and vocational educators accountable for the specifics of vocational education, but 3) still leave vocational educators with an extremely important stake in education for career.

The System's Status and Prospects

The Information System for Vocational Decisions has formally existed only since 1 June 1966. Since that time we have 1) assembled necessary personnel, 2) worked out our location in a complex University, and in collaborations with the Newton, Massachusetts School Department, and the New England Education Data Systems, 3) delineated our need for computational equipment, and 4) started the construction of computer routines and materials. We have also necessarily worked through a plan for our next twelve months, all within the first six months of our own existence. The past six months have been busy ones. However, despite occasional disappointments, I remain firm in belief that our theory is still accurate and possible.

The System is supposed to have a working prototype available by 1 July 1969. During our thirty-seven month project, we intend to bring the System through two generations of a prototype. The intention is to have practically complete and reasonably accurate specifications of an operating computer system for vocational decisions at the conclusion of the project. We will also have a working second generation prototype, of course.

Two roadblocks loom ahead. One block consists of the limitations of existing computational equipment itself. These limitations are in the small size and capability of most of the existing equipment, in the slow emergence and delivery of adequate equipment, and in the actual cost of adequate equipment in relation to our original estimates. The second roadblock is in Congressional action toward research in vocational education. The reduction of funds available during Fiscal Year 1967, under terms of the Vocational Education Act of 1963, may well bring about serious barrier to the possible conclusion of the Information System for Vocational Decisions.

Personally, I think it is a shame for the country not to move rapidly to completion of this Information System project. I trust that I have given you some sense of the possibility inherent in the Information System in these short remarks. Personally I think that the System's possibility for maturing understanding of the vocational role in living are considerable. I sincerely hope that you vocational educators will continue to lend your interest to the System.

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INFORMATION SYSTEM FOR VOCATIONAL DECISIONS

Project Report No. 3

A THEORETICAL FOUNDATION FOR THE USE OF OCCUPATIONAL INFORMATION IN GUIDANCE

Robert P. O'Hara

This paper was supported in part by Grant No. OEG-1-6-061819-2240 of the United States Office of Education under terms of the Vocational Education Act of 1963.

Graduate School of Education
Harvard Univ~~ersity~~ Cambridge, Mass.

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A THEORETICAL FOUNDATION FOR THE USE OF OCCUPATIONAL INFORMATION IN GUIDANCE

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Introduction

Career development is a process. Students are engaged in this process and the subject matter in school is either directly or indirectly related to their career development. Many of the relationships are obvious as in the case of shop courses. Others are not quite so clear as in the case of World History. This paper takes the position that successful consideration of vocational developmental tasks will function either directly or indirectly as an integrating factor in the personalities of our youth. The emphasis here is on the vocational developmental process, the gradual acquisition of knowledge about the world of work, of knowledge about the student's own vocational potential, and the increasingly clear understanding of how this potential is fulfilled through school and work. For most students, the academic identity is a developmental stage, while the vocational identity in our culture is the principal identity perfecting the natural human personality.

In our theoretical approaches to career development we have overlooked a simple fact - that boys and girls learn how to be doctors, lawyers, plumbers, and nurses. As we look at them learning about the world of work, we become aware that their learning is somewhat like the traditional learning and somewhat different from it. The example which illustrates this arises from two factual statements. The first statement is $c^2 = a^2 + b^2$. The second statement is: A great many men with degrees in forestry work indoors at desks.

I imagine that I am teaching a group of boys age 15. Two of these boys are thinking of becoming foresters. My nine o'clock class is in geometry. I teach $c^2 = a^2 + b^2$. The boys learn this. It is a kind of pure intellectual learning, an abstraction that is apart from life. At 9:50 I teach a course in occupations. In the place of $c^2 = a^2 + b^2$ I write, "A great many men with college degrees in forestry work indoors at desks." For the two boys considering forestry this is not abstract. It is concrete--it is probably new, and it may be shocking. It may have an effect on the core of the budding occupational identity that is beginning to provide personal integration. But there is a core of cognitive material here that must be grasped by the students. To make intelligent decisions they must have learned about careers.

This short paper will outline the basic theoretical approach to this problem which we are using. We have not abandoned affective elements, but we think that in recent years there has been such a concentration on affective elements that a researched understanding of cognitive approaches has been neglected.

The paper will outline some of the elements involved in the vocational learning sequence. It will discuss cognitive change which we expect will be motivational, and lead to behavior change.

Learning and Vocational Readiness

Readiness is a term used in learning theory. It is important to remember that vocational readiness can exist in differing kinds and degrees at every stage of choice and adjustment in the career development process.

Readiness depends on need. The vocational needs we are talking about are "acquired needs." They are a part of the American way of life, but vocational development, as we view it in the United States, is not an aspect of the development of boys and girls in every culture in the world.

Needs in the area of vocational development are developed through a socializing process. Since we are all socialized in different ways our states of vocational readiness will vary greatly. Even within some subcultures in the U. S. the question, "What will you do when you grow up?", asked in a career development context, may have no meaning because within that subculture careers are unknown--there are only ways of life which working supports.

This socially created state of readiness controls the expectations one has for "what is likely to lead to what." For example, an aspect of vocational readiness is the awareness on the part of the child that open consideration of career choices may lead to social approval from parents, counselors, teachers, and adults in general.

The vocational learner's expectations control or greatly influence (1) the amount of attention paid to a given vocational situation, (2) the aspects he will notice or respond to, and (3) the nature of the response. Grunes' (1956) research on the socially molded perception of job classifications is an example of this.

Need and readiness will determine how the student interprets the situation. Need and readiness will determine if, when, and how he will respond. If a student does not feel hungry, it is likely that he will not notice in any effectual way, ads for food. If a student is not vocationally hungry, he will not notice the job world. The vocational learning situation must provide objects, people, and activities with which the learner interacts.

All vocational learning is a function of motivation. The student acts to satisfy his vocational needs. Unless he has a vocational need, he will not pursue a course of action, nor will there be any vocational learning. The presence or absence of vocational need determines whether or not vocational action will result in a given situation. When we talk about vocational need, we mean that there is present a state of dissatisfaction in the student. The action resulting from this state is an effort to produce a state of vocational satisfaction. The quality and quantity of the dissatisfaction will determine the extent of the vocational activity of the student. The vocational responses of the student are determined by the nature of the situation and by the learner's condition of vocational readiness.

A major problem in the elementary and secondary school years is the creation of goal directedness. Involvement in the world of work at these early grade levels is minimal. The consequences of needing, noticing, and responding, are seldom very great. As a result, even the needing, noticing, and responding are diminished.

The author of this paper takes the position that since the vocational problem is generally posed in educational terms and unrelated to the vocational world during this time, and since secondly, the real vocational problems are extremely remote, the guidance personnel have an obligation to impose a formal learning situation with formal academic sanctions in order to create the goal directedness necessary for increased understanding of the world of work, and the numerous responses to it that are possible. We need to create situations in which the learner feels the consequences of decisions which he makes. The decisions are academic; the consequences are not merely academic, but achieve the ultimate goal of the counselor in expanding the occupational horizons of the student. Thus, with achievement of academic satisfaction, the student achieves simultaneously vocational satisfaction in that he has broadened his knowledge and understanding, and feels less tension in the vague and indistinct vocational situation which elementary and secondary education necessarily place him in.

The Learning Situation

The second element in the vocational learning process is the learning situation. The learning situation is always a problem for the learner. In our culture the problem is made doubly difficult by its remoteness. We are speaking here of remoteness in time. For the college bound boy, vocational satisfaction, that is, satisfaction deriving from learning new work responses, is postponed for years. Since satisfaction is remote the acuteness of perception of the problem is diminished precisely in its vocational terms.

At this point, the writer finds himself in a relatively paradoxical intellectual position. He feels constrained to urge the adoption of positive steps to create intermediate work satisfactions in order to increase the motivational power of the remote vocational goal. In doing so he would tend to advocate the development of a vocationally oriented academic identity.

On the other hand there is the awareness that those scholars who pursue humanistic studies for their own sake, who participate in the pursuit of truth alone, who delight in its acquisition, who become stardusty with ideas and feel the deep throb of human striving pulsing through nations and centuries - these scholars and their students may feel no tension. Their absorption in the academic identity is so great that the vocational problem not only becomes remote, it ceases to exist. We call these college years a moratorium, from the Latin word mora meaning delay, but to call this a delay is a value laden description. For at least in theory there is no delay. Rather, in terms of the academic identity, this is the springing time of the year, when there is a pure lyric quality about the wild intellectual enthusiasms of youth that helps to perfect the essential individualistic academic identity.

But for most of those we educate in this fashion, entrance into the world of work comes as a shock.

To give the vocational devil his due, there has been a "delay" and the delay has involved what the fledgling academic now discovers is the principle identity in twentieth century America - the vocational identity.

But the paradox must be resolved. We must make a unity of antinomies. At the very least we must build bridges from the academic world to the world of work. In school and college the problem of learning new intellectual facts is posed every day. The vocational choice problem is not posed every day. The choice of a course of study which may take place in March or April or May is remote from the academic behavior which must be successfully carried on in September, October, and November. The choice will not lead to satisfaction at once. Even for such minor vocational decisions satisfaction is delayed two, three, or even five months because this is the way the academic world is structured.

Vocational Cues

Further, the problem of learning new intellectual facts is set in a structured framework - a formal learning situation, but vocational learning is seldom so structured. The learning problem, the need for choice is posed at each educational-vocational level, but there is no provision for formal learning of the variety of responses.

Vocational readiness is the disposition to act in a certain way based on prior knowledge and observation. The student of vocational matters will have expectations that determine his attention. Those aspects of the vocational problem which attract his attention, we call vocational cues. Thus, vocational readiness involves readiness to interpret and respond to available vocational cues. The best vocational learning situation will be one in which the cues are in conformity with the student's state of readiness. At the outset, cues which the vocational student expects, are most suitable to him.

In addition, vocational cues must be such that the learner can distinguish those that are important to him from those that are unimportant. The cues must, therefore, be distinctive.

As the student grows older, vocational cues need to be patterned. In the earlier years, we may accept as his normal development a relatively simple approach in terms of likes or dislikes. But career development is a far more complex thing. Thus, in the later years of adolescent development, the simple assertion of likes or dislikes may signify immaturity. For such people, it is extremely crucial that the complex nature of career development be presented in a patterned, and thus more vocationally significant, fashion in order that the complexity of the situation may be grasped. The adolescent should be helped to perceive the relationship among variables involved in career development; for example, aptitudes, interests, and values. He must be helped to understand the notions of: relative importance, compromise, irreversibility, synthesis, and developmental process itself.

The world of work does not itself very often contribute to this kind of patterning. It presents with equal force to a young adolescent both appropriate and inappropriate vocational cues. If, for example, we were simply to throw the whole Dictionary of Occupational Titles at a student, he might get the impression of one "big bloomin' buzzin' confusion." If, however, we make entry to this vast storehouse of information through those areas in which he manifests some degree of readiness, we can by sequencing the steps of his approach, assist him in understanding and imposing some increased degree of rationality upon his study of his own vocational development.

When the vocational learning situation is not structured in formal fashion, the vocational responses will be less intellectual, less rational, more haphazard, more subject to trial and error. This is where we find the majority of our juniors and seniors in college. The nation does not benefit by such a neglect of its resources.

Symbolization

In the third stage in the vocational learning process the learner interprets the situation. Interpretation is both cognitive and emotive. Tiedeman and O'Hara (1963) have dealt with the interpretation of the vocational learning situation in terms of differentiation and integration. There is no need to deal with those aspects of the process here. But a kind of cognitive interpretation which simultaneously deals with emotive interpretation is symbolization. It is precisely here that the role of the counselor and the teacher of occupations enters.

Most psychologists stress the need for symbolization in affecting psychological growth and development. The chief mode of symbolization for human beings is through words, although any sign at all can be a symbol. Madison Avenue has capitalized on attention-getting symbols to characterize the qualities of their products. But words are the most common cues whereby we understand our environment. Through words we come to differentiate and integrate the world around us. Differentiation is more easily achieved the more words we know. Integration is more easily achieved the more words we know. And yet, although this principle of learning is generally accepted in education and psychology, no one has used it as yet to put theoretical foundation beneath that aspect of guidance called occupational information.

The more occupational words a student knows, the more he will be able to differentiate and integrate within the occupational world. He must learn the language of vocations. He must use words, symbols, to explore vicariously the world of work, to talk out and act out with his friends, with parents, teachers, and counselors, vocational roles which he may be considering. In general, the more he does this, the better able he will be to differentiate and integrate. It is precisely this principle that vocational psychologists have neglected. Under the impact of increased awareness of the interaction of personality with vocational development, they have failed to hold on to the fundamental conception of learning as a part of vocational development. Abandonment was furthered by an awareness that much of the occupational information that was available was quickly outdated.

But for the growing and developing boy or girl, the value of the information does not lie in its up-to-dateness, but in its capacity to lead to an increased understanding of career development in the world of work. This understanding comes about principally through the manipulation and study of the symbols of that world. Therefore, we must not only use words as a principal focus, but following Madison Avenue's true understanding of the way people learn and become aware of reality, we must use all kinds of symbols, pictorial and auditory, as well as verbal.

Conclusion

If, as vocational counselors, we are going to assist the vocational development of our students in such a way as to produce vocational maturity, then we are inevitably going to be involved in a learning process. We know a great deal about learning, but we have not applied it in the vocational area.

Without information, the vocational learner's responses tend to follow habitual, inadequate patterns. The introduction of knowledge, cracks the mold of some of these patterns, and thus shifts the expectations and consequences which result from vocational activity.

If we teach the student to make increasingly more adequate vocational differentiations and integrations, then our theory says that the result will be more adequate vocational responses. If we do not provide the student with some kind of occupational and career information, the range of possible responses will not be open to him. He will be a vocationally deprived child. Guidance counselors must intervene in the habitual perception of the vocational world, to broaden that perception, to open up the number of options available, and to have each option clear, distinct and patterned in accordance with the unique interests, abilities, and values of the student.

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INFORMATION SYSTEM FOR VOCATIONAL DECISIONS

Project Report No. 4

SUGGESTIONS FOR TREATMENT OF INFORMATION ABOUT OCCUPATIONS

Richard M. Durstine

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SUGGESTIONS FOR TREATMENT OF INFORMATION ABOUT OCCUPATIONS

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Introduction

During the past summer my colleagues at CSED put together a great deal of information about quite a lot of occupations (c. 900), arranged it in orderly form, and placed it on magnetic tape for future processing. One of the next problems we face is how this information should be used and kept up to date. This has been discussed on various occasions, but usually in a very general way.

This working paper seeks to examine in more explicit terms how we might proceed in our use of this information. I have incorporated here many ideas and suggestions from other workers. Much of this material will therefore be familiar. But I hope some purpose is served in collecting and recording these ideas before going on to more detailed work.

The discussion centers on a modular system for information treatment. We expect to develop our data and methodology consistent with the lines indicated, working closely with Ellis' group throughout.

Although I have not relied directly on the Tiedeman paradigms, I hope that my approach will prove compatible with them.

General Goals

This paper follows certain principles I believe vital to the success of our work. First, our primary task with regard to information should be synthesis. We should avoid developing raw data (we haven't the resources), but should collect it in as refined a form as we can, consistent with our needs. We should not put as much effort into deciding on the validity of information as into preparing for its use, development, and variation. Second, experimentation with the form and content of vocational information, regarding both occupations and industries, will go on for a long time, and our system must be prepared with this in mind. This will be possible only if the system is conceived as an interconnected set of individual parts each of which can be removed, improved, or replaced with minimum disruption of operation. In this way we can start with minimal capability, and allow the system to evolve, part by part, as our understanding develops.

There are several ways in which we might use our information about occupations. First, we should like the student inquirer to be able to query the system directly about the characteristics of a broad range of given jobs ("What does a candle snuffer do?", "What high school courses does a chicken sexer need?") or industries ("How many people work in the auto industry?"). He should also be able to select occupations or industries in terms of chosen characteristics ("Which jobs involve a great deal of travel?"). Compound questions should also be possible ("Which jobs involve a great deal of travel, working primarily with things instead of people, and require no mechanical aptitude?"). He ought also to be able to get suggestions for possible jobs by stating his preferences ("I like working with things and being out of doors."). It should be possible, too, for the system to suggest and guide his inquiry if he is unsure how to proceed.

Not directly related to the inquirer, but vital to the proper operation of the system, will be the ability to organize, update, and revise information. Two sources seldom occur in the same form, but it is important to be able to use them all. To achieve the needed flexibility as a part of normal operation, the modular design suggested above will be relied upon. If there is to be a suitably free dialogue between the system and the inquirer, flexibility of input and output (communication between inquirer and system) will also be important.

Putting Information into the System

The information that the system will use is of two types: information about the inquirer, and information about the existing jobs. The latter information will include both occupations and the industries in which they occur. This will be stored within the system and not vary from interview to interview. It will be changed only as a part of system revision. The information about the inquirer, on the other hand, will be temporarily kept in the system only for the duration of the interview (plus whatever permanent interview records are decided upon). This includes both objective information (e.g., personal data, grades, test scores) and subjective statements which will guide the course of the interview.

Each source of information about occupations or industries tends to be broken down according to different categories. For the compatible use of all sources, we cannot take them directly, but must translate to a standardized set of categories. This was done by hand in the initial collection of information about 900 jobs. Hopefully, translation routines can be developed to make this task automatic in the future. A standardized structure, and the treatment and translation of the individual sources within it, must be prepared soon, and with considerable care and attention.

Getting Information Out of the System

Information about occupations and industries will be stored for the express use of students in choosing and planning their educations and careers. It is essential, therefore, that it can be recalled as will best serve their ends. Ways of getting information out of the system will be described here in terms of five principal modes of operation.

MODE 1 - SIMPLE RECALL BY OCCUPATION, INDUSTRY, OR TRAIT

In this simplest mode, the inquirer asks for specific information about a given occupation or industry. He may make this request in informal language, but the system will probably interpret it in one of several structured forms, e.g.,

"Does a (x) (y)?" ("Does a candle snuffer travel a lot?")

"Are (x)'s required to (y)?"

"Are (x)'s often employed in the (y) industry?"

The number of such forms should be limited, but carefully chosen to allow a comprehensive range of questions. The system will search under the given occupation and recall the desired information, preferably through a statement in the English language. It should also be possible to call forth a short prose composition about the job or industry, which has previously been stored for this purpose. Other information and references for further investigation of the occupation might be included, as well as a routine for the translation of unlisted requests into listed occupation or industry titles.

MODE II - SELECTION BY TRAIT

In this mode the system will begin to help the inquirer select jobs which can then be more fully examined under Mode I. A given trait is chosen by the inquirer and the names of all those stored occupations having this trait is made available by the system. This will involve selecting from the stored list of occupations on the basis of desired traits.

Examples: "Which occupations involve some but not a lot of travel?"

"Which occupations involve college education but not an advanced degree?"

The types of queries possible will be made known to the inquirer so he can use the system fully and effectively. The output will be given to the inquirer piece by piece at his request and in a predetermined order (e.g., starting with the jobs most in demand) to avoid swamping him with a lengthy list.

The inquiry need not in fact be in terms of named occupations or industries, but might relate traits directly, e.g., "Are indoor jobs likely to involve more or less travel than outdoor jobs?"

MODE III - SELECTION BY MULTIPLE TRAITS

As a logical extension of Mode II, the system can help the inquirer select possible jobs by doing some preliminary sorting for him. He will of course be free to revert to one of the lower numbered modes for further information. In Mode III he will list some traits he wishes his job to have or not to have. He might also at this point introduce test scores and other objective personal information to further help the system to select suitable occupations.

The system will eliminate occupations in the manner of Mode II until all requirements indicated by the inquirer have been used. If the list is not evacuated by this process (i.e., if the subject is not so fussy that no jobs can please him) the system will proceed as follows:

> "There is a list of (x) jobs suitable by your criteria."
>
> "All of these have the following traits in common: (u), (v),.... (w)."
>
> "The following additional traits are possessed by at least one of these jobs: (a), (b),.... (c)."

The inquirer can then further refine his choice by adding, changing or eliminating certain traits. Or he may call for the derived list, which he can then examine in the manner of Mode I.

If the inquirer's desires are so severe that he gets a vacant list, he can try again, or be offered a list of occupations that differ in only one respect from his requirements. In this way he can be helped explore the job list until he finds a suitable job or set of jobs to investigate in more detail.

MODE IV - SELECTION BY SCORING AND EVALUATION

This is an extension and refinement of Mode III, and can be considered either in addition to or instead of it. Here the inquirer not only specifies traits, but evaluates them in words ("like," "dislike," "like very much," "dislike mildly"). The system will translate these statements into numerical scores according to pre-established rules. The scoring might be further refined by asking the inquirer to attach weights to his preferences (e.g., indicating that his desire to make a certain minimum income is much more important than his objection to a lot of travel). Each job will then be given a score on this basis, and a list ordered by decreasing score made available for the inquirer to draw upon.

This scheme is liable to the objection that the inquirer seems to have a choice being made for him without his full control, since he will not fully understand the things the system will be doing to make this ordered list of jobs. This objection need not be a valid one. The entire list is available to the inquirer. He can sample as much of it as he likes. And he can revert to the other modes for further information whenever he desires. Also, he might be shown on request how each job obtained the score it did on the basis of his stated preferences. He can then if he wishes, change or add to these preferences and see how this affects the scoring.

In effect he is being allowed and helped to write a computer program for job evaluation based on his own needs, in a very specialized, but still somewhat flexible programming language.

MODE V - PLANNING TO IMPLEMENT VOCATIONAL DECISIONS

The previous modes helped the inquirer to examine single job possibilities. It can also help him hedge his decisions against risk by planning composite programs that will leave satisfactory alternatives open to him in case his first choice fails. The system can help him anticipate and plan in detail for his future in terms of school courses, time, costs, risks, and in the selection of colleges, training programs, and entry occupations.

In Mode V the inquirer will indicate to the system a set of jobs that interest him. The system will respond with information about the preparation needed for this set as a whole, the rewards and risks involved, and perhaps other relevant information. The inquirer can thereby examine what various possible decisions would imply, and be thus aided in making a career decision that suits him.

In each mode except the first, the inquirer will sometimes call information from the system, and sometimes be given information automatically. Mode I will involve only recall at the command of the inquirer. In the higher modes, the system will sometimes volunteer information of particular importance. This will include suggestions designed to help him decide what further information to request or to put into the system.

RELATION TO PARADIGMS

Although the modes of operation suggested here were not selected with the ISVD paradigms in mind, a rough relation between modes and paradigms is possible:

Paradigm: Exploration - Modes I, II;
Crystallization - Modes II, III, IV;
Choice of Planning - Modes III, IV, V;
Clarification - Modes V, I.

There is not a one-to-one correspondence here between modes and paradigms, nor should there be. The student's use of the system from paradigm to paradigm will be facilitated if there is some overlapping. It is also interesting to note that the paradigm sequence both begins and ends with Mode I.

System Components

The components and structure of the information system implied by the above outline will now be discussed separately. The components, briefly described, are listed below.

Input Translator - will convert the questions and requests of the inquirer into the form in which the system will handle them. The degree to which we must restrict the language that the system can accept has yet to be decided. Structured inquiry will generally be cheaper to accommodate than natural language, but has the disadvantage of limiting the dialogue between inquirer and system. One advantage of modular design is the possibility of starting with less than ideal elements (in this case a highly structured communication between inquirer and system) and then improving system capability by gradual and separate improvement of each of its elements.

Inquiry Record - a list for future reference of what the inquirer asks the system for in Modes I and II. In Modes III, IV, and V, when the inquiry develops into a dialogue or interview, this will become known as the Interview Record.

Interview Record - a list for future reference of what the inquirer has asked for during his interview with the system and what the system has responded.

Information Sources - the raw material on occupations and industries, in a form as well adapted for system use as possible.

Information Translator - will convert the source information into a form suitable for formal system operation. At first this translation will be manual, but we can hope eventually for machine translation within limits.

Information Store - the repository of information translated from the information sources and ready for use in system operation. This store will vary somewhat from mode to mode, or might be adapted to serve more than one mode simultaneously. In general it will be divided into an addressable list, to which requests for information can be keyed, and a passive list, from which information can be recalled but which cannot be addressed directly. It may at some later time be better to think in terms of a set of several such information stores, suitably linked to one another.

Sorter - will select information from the information store according to the preferences and requirements of the inquirer, and prepare this information in a form suitable for his use in Modes I, II, and III. In Mode IV this role is taken by the Evaluator, and in Mode V by the Requirements Processor.

Selection - the result of the sorting process, when this result is a single piece or set of information (Mode I).

Selection List - the list of items that result from the sorting process, ordered in some predetermined fasion so that they can be recalled one by one or in groups by the inquirer to meet his information requirements.

Output Translator - will convert the results of system operation into a form intelligible to the inquirer. This may include changing code to words and numbers; constructing sentences, tables, and graphs; or calling up audio or visual presentations. This is an important element and deserves considerable attention, though the problem here is less than that for the Input Translator because the format of the response is under the control of the system. The output translator should be able to reproduce the inputs to which it is responding as well as report the results of the sorting and other selection processes.

Trait Union List - in Mode III, the list of traits held by at least one of the jobs on the inquirer's Selection List.

Trait Intersection List - in Mode III, the list of traits held by all the jobs on the Inquirer's Selection List.

Evaluator - will evaluate (in Mode IV) the various jobs in the Information Store and list them in order of decreasing total score, according to the objective traits and subjective preferences of the inquirer.

Evaluation Register - the list of jobs obtained by the Evaluator in Mode IV in decreasing order of total score, with perhaps some information explaining how that score was obtained.

Requirements Processor - in Mode V, the requirements for preparation for and entry into various jobs will be listed and combined by this processor, in seeking feasible combinations of actions that will prepare the inquirer for an acceptable set of alternative careers.

Plans Register - in Mode V, the summary of actions, expenditures, etc. that the inquirer must go through to prepare for a chosen career or package of careers.

System Structure

The way in which the components just listed will fit together to function as a system must be described separately for the several modes of operation. This is done here in pictorial form (Figures 1-5). The arrows in the figures indicate communication from one component to another. The rectangular elements are permanent parts of the system and will not change from interview to interview except for changes in or updating of the system itself. The circular elements relate to the individual interview.

Figures 1-5 are meant to give only a rough schematic idea of how the system will function. Each of the components shown in the figures and mentioned in the preceding section will be a complex entity that must be designed with considerable attention. The present intent is to indicate only the nature of these components, and to identify them for subsequent development.

Each mode of operation includes input and output translators, information sources and translators, and an information store. The nature of these common components might well be different for the various modes, particularly in the case of the input and output translators. We will do well to start with the simpler modes and work toward the more complicated ones, including the capabilities developed for the simpler ones as part of each successive stage. Thus, for example, Mode I is available to each of the higher modes to answer specific questions from the inquirer as they arise.

The various system components and the operating modes in which they occur are summarized in Table 1.

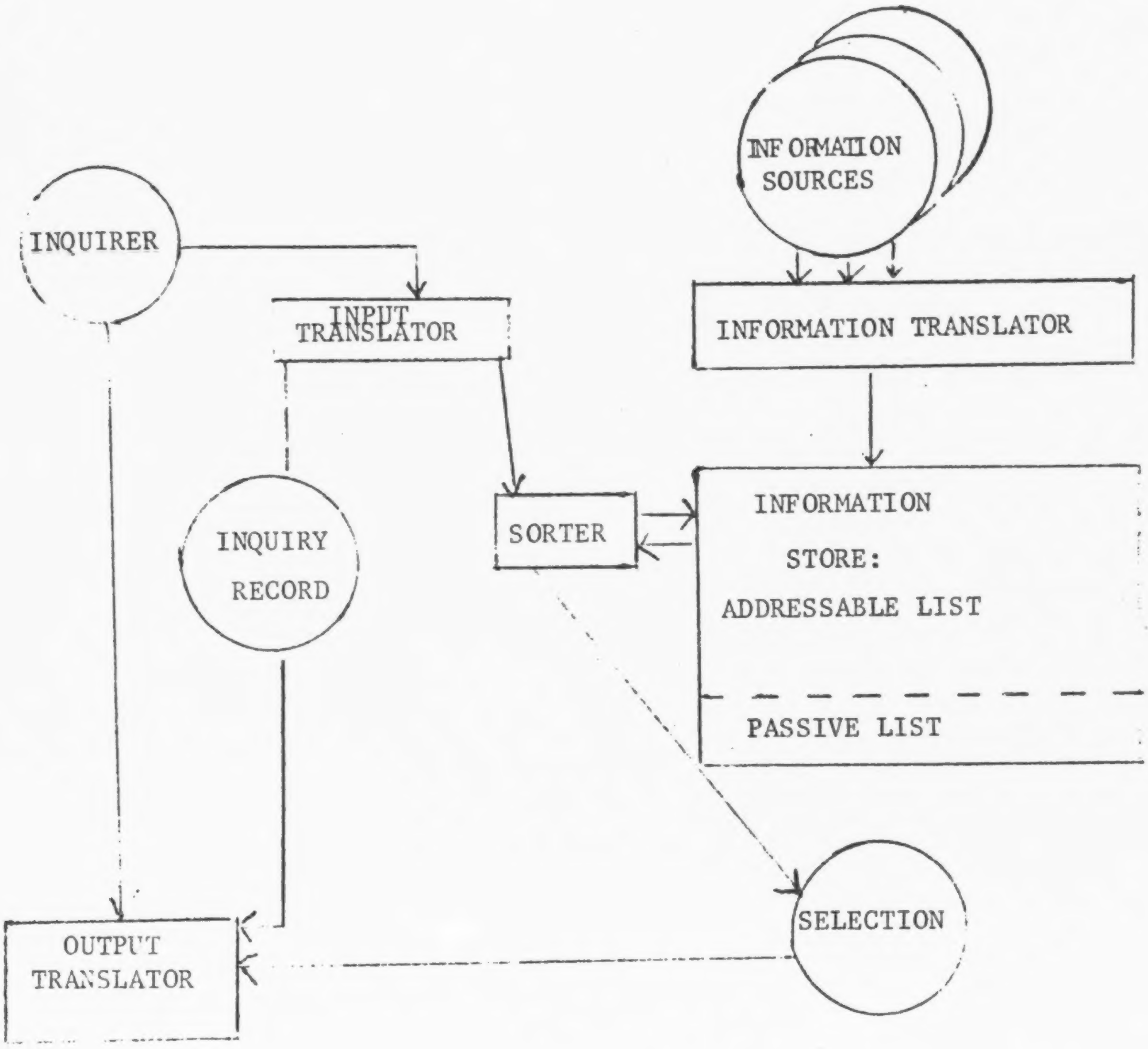
INFORMATION SOURCES
INQUIRER
INPUT TRANSLATOR
INFORMATION TRANSLATOR
INQUIRY RECORD
SORTER
INFORMATION STORE: ADDRESSABLE LIST
PASSIVE LIST
SELECTION
OUTPUT TRANSLATOR

Figure 1

STRUCTURE OF SYSTEM OPERATION FOR MODE I

(Simple Recall by Occupation, Industry, or Trait)

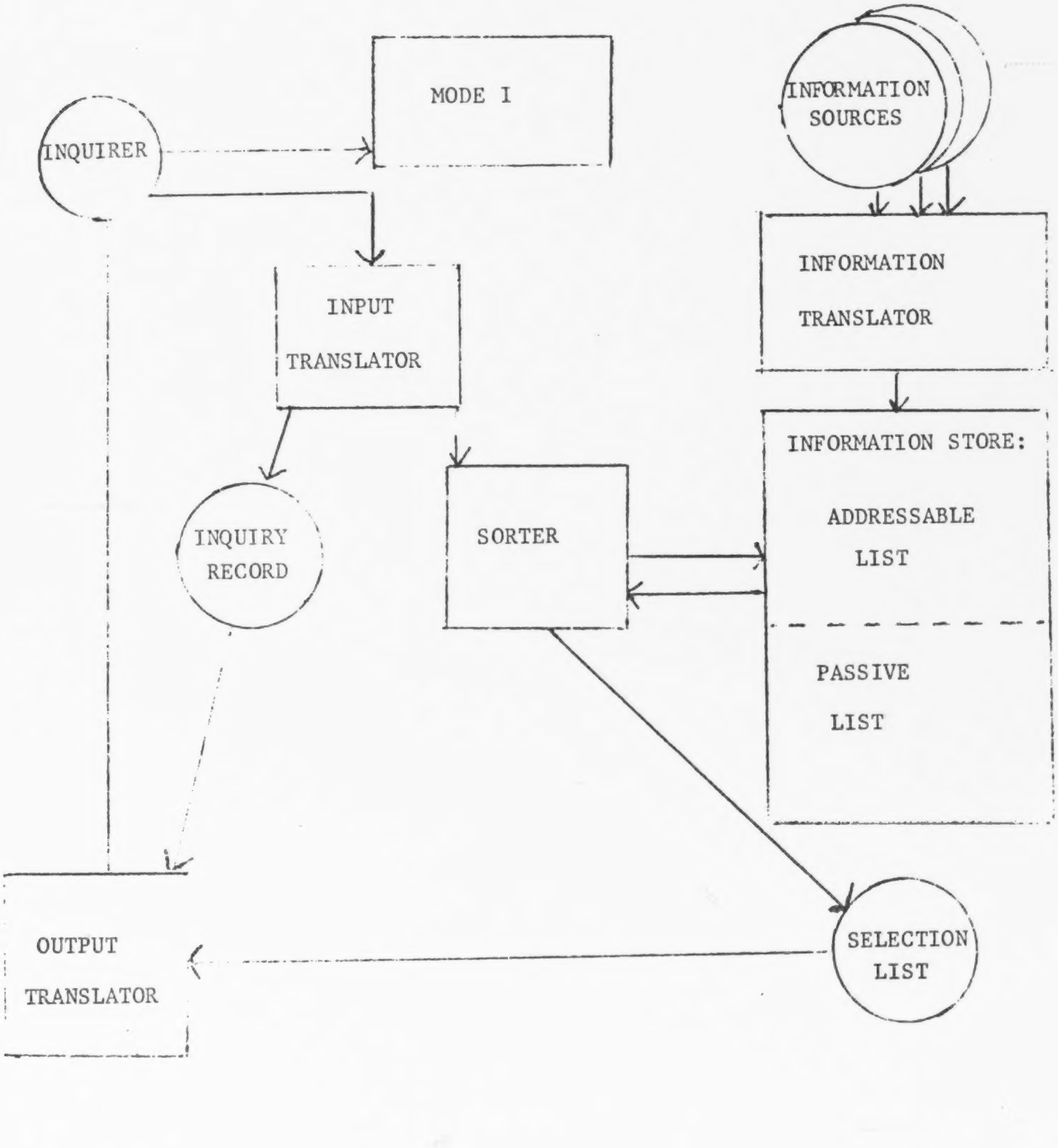
MODE I
INQUIRER
INFORMATION SOURCES
INPUT TRANSLATOR
INFORMATION TRANSLATOR
INFORMATION STORE:
ADDRESSABLE LIST
PASSIVE LIST
INQUIRY RECORD
SORTER
OUTPUT TRANSLATOR
SELECTION LIST

Figure 2

STRUCTURE OF SYSTEM OPERATION FOR MODE II

(Selection by Trait)

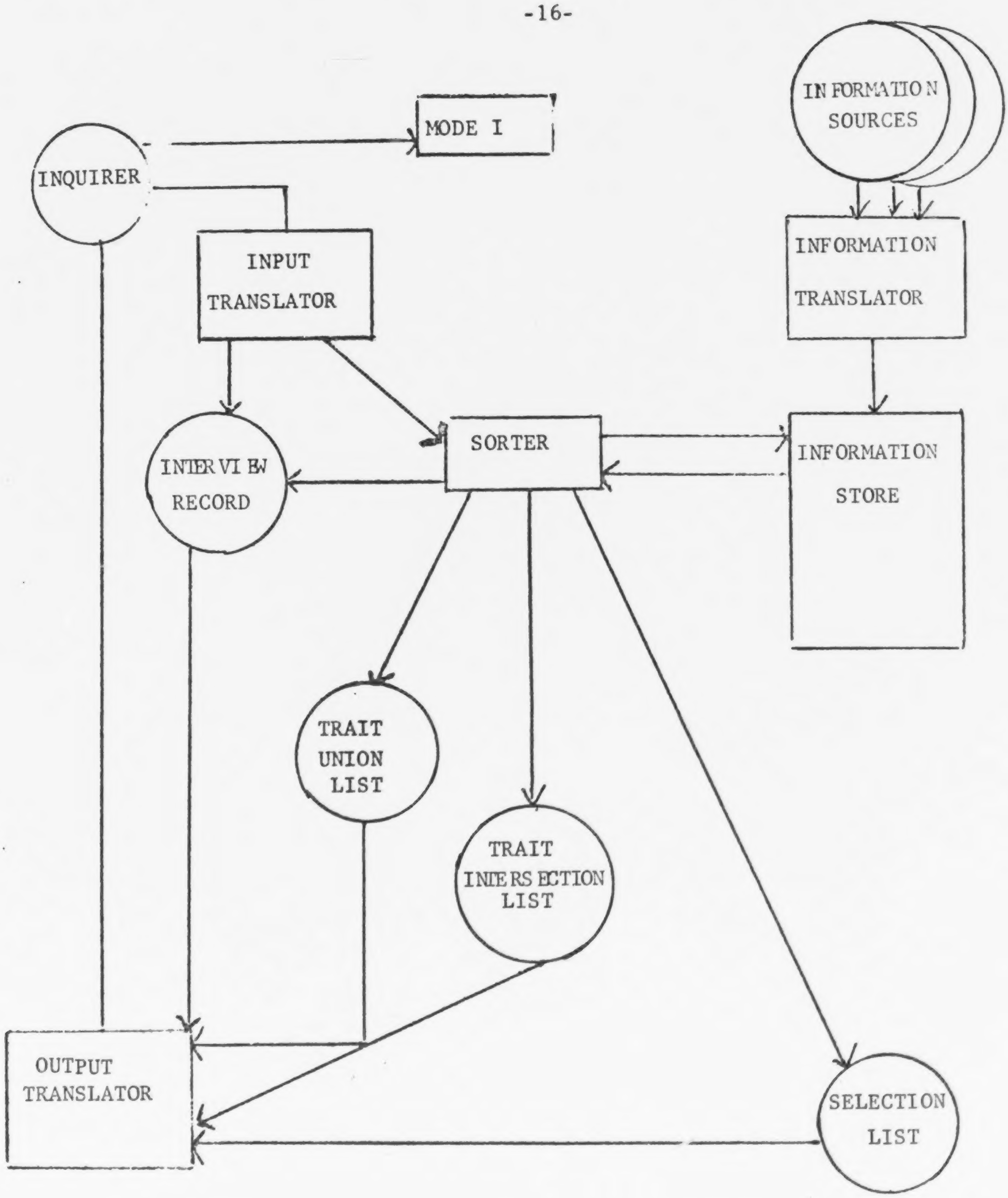
MODE I
INQUIRER
INFORMATION SOURCES
INPUT TRANSLATOR
INFORMATION TRANSLATOR
SORTER
INTERVIEW RECORD
INFORMATION STORE
TRAIT UNION LIST
TRAIT INTERSECTION LIST
OUTPUT TRANSLATOR
SELECTION LIST

Figure 3

STRUCTURE OF SYSTEM OPERATION FOR MODE III

(Selection by Multiple Traits)

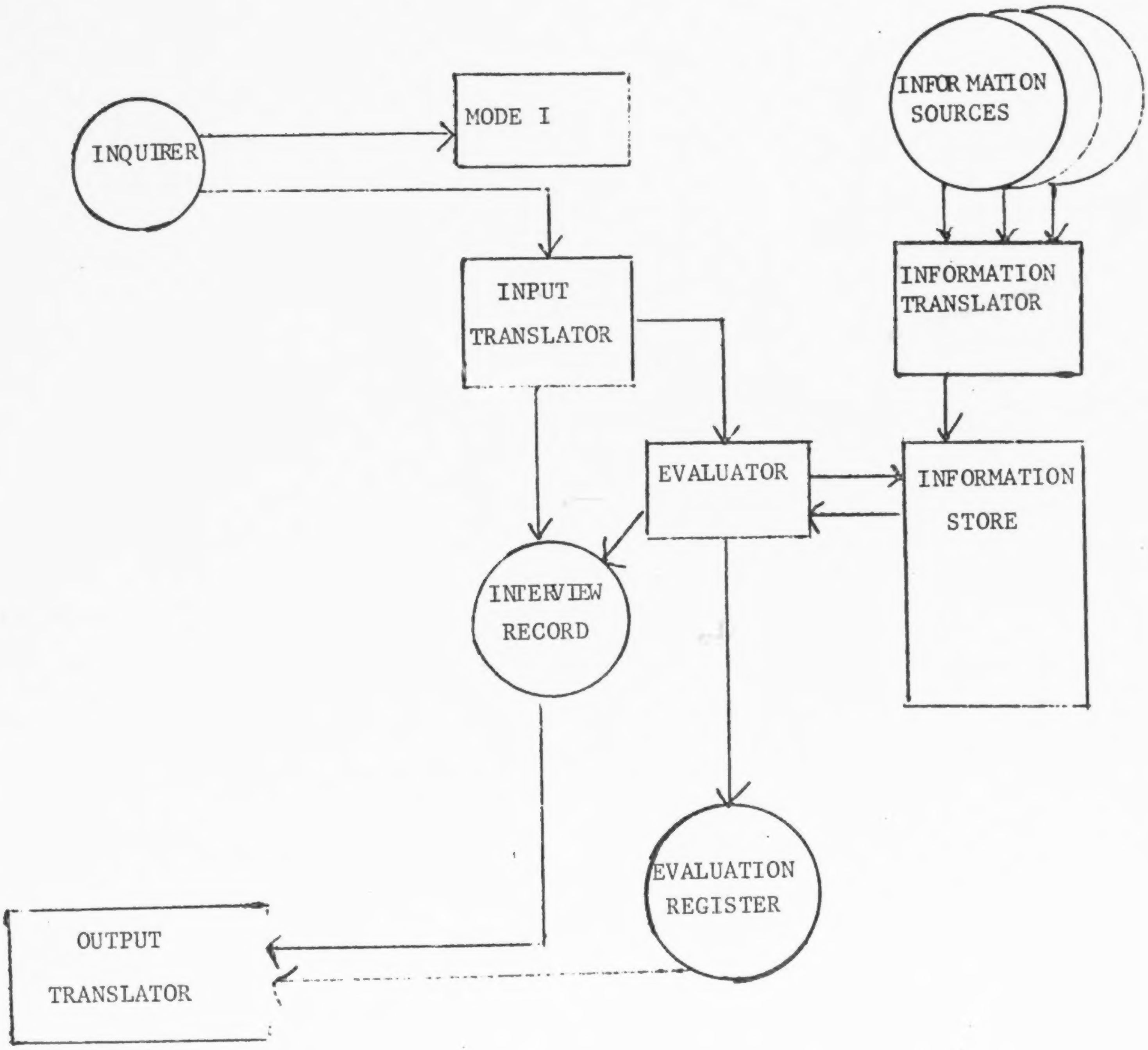
INQUIRER
MODE I
INFORMATION SOURCES
INPUT TRANSLATOR
INFORMATION TRANSLATOR
EVALUATOR
INFORMATION STORE
INTERVIEW RECORD
EVALUATION REGISTER
OUTPUT TRANSLATOR

Figure 4

STRUCTURE OF SYSTEM OPERATION FOR MODE IV

(Selection by Scoring and Evaluation)

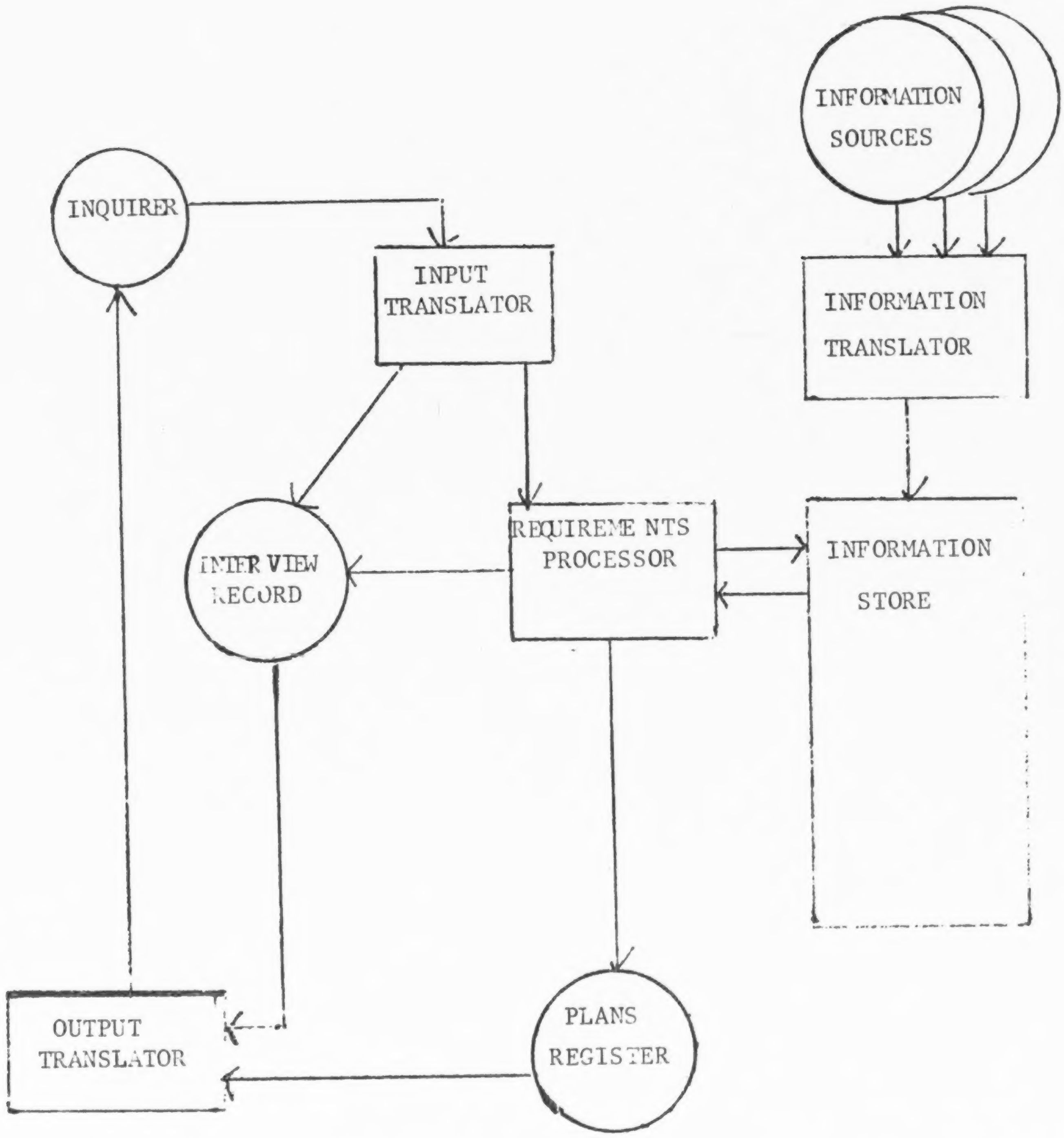
INFORMATION SOURCES
INQUIRER
INPUT TRANSLATOR
INFORMATION TRANSLATOR
INTERVIEW RECORD
REQUIREMENTS PROCESSOR
INFORMATION STORE
OUTPUT TRANSLATOR
PLANS REGISTER

Figure 5

STRUCTURE OF SYSTEM OPERATION FOR MODE V

(Planning to Implement Vocational Decisions)

	MODES				
	I	II	III	IV	V
INPUT TRANSLATOR	x	x	x	x	x
INQUIRY RECORD	x	x			
INTERVIEW RECORD			x	x	x
INFORMATION SOURCES	x	x	x	x	x
INFORMATION TRANSLATOR	x	x	x	x	x
SORTER	x	x	x		
INFORMATION STORE	x	x	x	x	x
SELECTION	x				
SELECTION LIST		x	x		
OUTPUT TRANSLATOR	x	x	x	x	x
TRAIT UNION LIST			x		
TRAIT INTERSECTION LIST			x		
EVALUATOR				x	
EVALUATION REGISTER				x	
REQUIREMENTS PROCESSOR					x
PLANS REGISTER					x

Table 1

RELATION OF SYSTEM COMPONENTS
TO MODES OF OPERATION

Conclusions

The path ahead is fairly clear if we think in terms of handling the simplest modes first. We already have information inputs from several sources, with more readily available. The former have been translated by hand to an information store that is well enough structured for initial experimental processing. Working on this base, we need to consider several subsequent steps. The order of the list below is correlated, though probably not perfectly, with the sequence in which these tasks should be done.

1. Development of prototype input and output translators, so the data can be quizzed experimentally in English. This might to some extent follow the form of McDade's recent memorandum on quizzing the data base, and/or rely on ready-made programs.
2. Preparation of means for searching the information store. This capability is probably in part available ready-made in the programs that Ellis has gathered.
3. Experimentation with live inquirers to see how some of the early modes will work out. If the amount of information becomes a practical problem, the abbreviated list of jobs supplied to us by I. Lerer could be used.
4. Examination of possibilities for better structuring of the information central store, and possible mechanized procedures for translation from information sources to the information store.

5. Development of detailed forecasting methods, using the computer. Besides the forecasts themselves, we might hope these would yield insight into information structure, and how the higher modes might be implemented.

6. Preparation for more advanced sorting techniques (as suggested under Mode IV) and for scoring and evaluation algorithms (Mode V).

Correction, improvement, and expansion of the data base can be expected to continue throughout.

In general, it looks as though the logic of information treatment should be fairly straightforward, though it requires careful attention. The translation routines, particularly for input, and the proper design and use of the information store will likely be the really difficult part.

As a stimulus to discussion I should like to suggest the following questions as representative of the kind we must soon answer.

> Do the suggestions made here call on a reasonable level of computer technology, particularly insofar as software is concerned?
>
> Does the proposed modular form indeed provide the open ended flexibility of system operation and development we seek?
>
> Can we adapt this approach to all kinds of information, from the most structured and quantified to the most qualitive?
>
> Can we update, amend, and revise the information easily, and readily make changes in the method of processing?

INFORMATION SYSTEM FOR VOCATIONAL DECISIONS

Project Report No. 6

FORECASTING FOR COMPUTER-AIDED CAREER DECISIONS: PROSPECTS AND PROCEDURES

Richard M. Durstine

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Harvard University, Cambridge, Mass.

March, 1967

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FORECASTING FOR COMPUTER AIDED CAREER DECISIONS:
PROSPECTS AND PROCEDURES

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Introduction

This paper is the second step in the preparation of forecasts of occupational and industrial information. It extends and develops the ideas of Russell G. Davis' recent survey of forecasting methodology (Reference 1), using forms, procedures and work programs designed to the needs of the ISVD project.

The eventual aim, for which these necessary foundations are now being laid, is to combine information from diverse sources and thus to provide forecasts more complete and comprehensive than are now available. This can be done only through carefully designed computation routines, which will take some time to develop, test and put into operation. The present paper fills the gap between the basic methodology (Reference 1) and the working routines. It should also serve as a basis for discussion in planning for and preparing those routines.

The following are the goals of this effort:

a) Ability to collect and absorb in explicit form and with minimum distortion any objective statement about the future of occupations or industries and their attributes, and to relate such statements to one another.

b) Specifically, projections of employment, earnings, etc., for future years by occupation and by industry, in as much detail as the available sources of information permit.

c) Separate treatment of short and long range projections, making use of different sources of information for these two classes of projections.

d) Provision for

Finding
Collecting
Organizing
Storing
Processing
Retrieving

information in as general a form as possible.

The underlying attitude throughout is that the limited resources of ISVD make it presumptuous to prepare new forecasts, except on an experimental basis. The primary job will therefore be to assemble and integrate what has been prepared by others, to interpolate where gaps exist, and to identify deficiencies. Experimental development of further forecasting capability is possible, but only after existing material has been thoroughly tapped.

The remaining discussion will begin with a fairly abstract discussion of the terminology and principles to be used. This will be followed by the application of these principles to the collection of information from the available sources. This approach will then be shown to be a consistent extension of the methods given in (1).

Method and Terminology

The logical constructs and terminology that will be used repeatedly in developing forecasts for career decisions will now be explained briefly. If the reader finds this description excessively abstract, he can proceed directly to the next section, where the presentation is more applied and explicit, and use this earlier material as a reference.

Information will be identified here in terms of coordinate dimensions and content dimensions, where

a) Coordinate dimensions describe the situation (e.g., industry, occupation, time) to which the information refers. They can be thought of as the identifying labels on the rows and columns of a table or matrix.

b) Content dimensions describe the nature of the information (e.g., population, average earnings, level of employment). Clearly, what is a coordinate dimension in one instance may be a content dimension in another, so the two are not always distinct. In context, however, they will usually be distinguishable from one another.

The dimensions (particularly the coordinate dimensions) can be separated into

a) Scaled dimensions, to which a numerical scale, either continuous or discrete, can be attached. These dimensions admit both to values specific to a particular point on the scale, and to averages or totals over intervals of the scale. Time and age are such dimensions.

b) Unscaled dimensions, to which no scale can be attached. These dimensions must be broken into exhaustive and mutually exclusive categories. Examples are industry and occupation.

When dimensions are unscaled or when scaled dimensions are treated in terms of intervals, the total range of possibilities covered will be called the domain of the dimension, and the exhaustive and mutually exclusive set of categories or intervals that cover the domain will be called its partition. A domain can have several distinct partitions, of course.

Information content, when expressed in quantitative terms, can be given as:

a) Total quantity associated with a relevant point, interval, or category.

b) Level (e.g., average value) of the quantity within a category or interval. This level will relate to total quantity through some measure on the category or interval. (e.g., Wage level for an occupation is related to total wages through the number of persons pursuing that occupation. Here number of persons is the measure, and the individual occupations are the categories.)

c) Fraction of the total quantity in the domain that is contained by a category or interval.

For theoretical work and for abbreviated identification, the following nomenclature will be used to describe information content:

	Quantity	Change in Quantity	Rate of Change
Total	Q_j	S_j	R_j
Level	$\overline{Q}_j$	$\overline{S}_j$	$\overline{R}_j$
Fraction	q_j	s_j	r_j

where the subscript j refers to the type of content (population, earnings, etc.) which must always be clearly identified. Clearly, change and rate of change must always be expressed in terms of some scaled coordinate dimension.

Let the domain of a dimension (or of a space spanned by several dimensions) be represented by Δ_m and the partitions within Δ_m by p_{mn}. Let the individual cells of the partition be identified by the index h. Then

$$\sum_h q_j(h) = 1 \quad \text{(fractional parts must sum to the whole)}$$

$$\sum_h s_j(h) = \sum_h r_j(h) = 0 \quad \text{(changes in fractional parts must cancel out)}$$

where $q_j(h)$, $Q_j(h)$, etc. will be used as short forms, where

$$q_j(h) = q_j(P(h)) = q_j(P_{mn}(h))$$

$$Q_j(h) = Qj(P(h)) = q_j(P_{mn}(h))$$

etc.

The shortest form consistent with clarity will usually be used. Also

$$Q_j(h) = W_i(h)\ Q_j(h)$$

where $W_i(h)$ is the weighting function or measure, mentioned earlier, defined on P_{mn}, that relates level to total quantity. The index i is included to distinguish among such measures. Note that W_i is itself a form of information content, renamed to emphasize the special purpose it serves here.

Another relevant general formula is

$$q_j(h) = \frac{Q_j(h)}{\sum_h Q_j(h)}$$

which converts totals to fractional parts that sum to unity over the domain Δ_m.

The total of Q_j over the domain Δ_{mn} will be denoted by $Q_j(\Delta_{mn})$, where the subscript n is needed in case there is a difference in Q_j depending on the partition of Δ_m. Then

$$Q_j(\Delta_{mn}) = \sum_h W_i(h)\,\overline{Q}_j(h)$$

and the level of Q_j over the entire domain is

$$Q_j(\Delta_{mn}) = \frac{\sum_h W_i(h)\,\overline{Q}_j(h)}{\sum_h W_i(h)}$$

So $\sum_h W_i(h)$ plays the same role in relating $\overline{Q}_j(\Delta_{mn})$ to $Q_j(\Delta_{mn})$ as did $W_i(h)$ between $\overline{Q}_j(h)$ and $Q(h)$.

Collection and Preparation of Information

For applied work, domains and partitions must be identified in terms of specific individual coordinate dimensions, from which more complex domains and partitions can be constructed as needed.

Information will be gathered from a variety of sources, stored in a consistent manner, and combined to be used, insofar as possible, as an integrated whole. Some of the more fruitful of these sources are shown in References 2 through 4.

The procedure to be followed in gathering, preparing, and treating this data will be as follows:

a) Survey available information sources. To this end, procedures for both preliminary and detailed surveys must be devised. These procedures will be outlined later in this memorandum.

b) Collect and store this information.

c) Devise routines for its manipulation, and in particular for improvising information that is not directly available from the original sources.

The intent is to have a structure able to treat a broad range of information. We thus need a knowledge of which information is, or is likely soon to be, available. Experimentation with small segments of this information will serve to test out the structure. Subsequent collection, inclusion, and use of information will depend on its availability and on the needs of the ISVD project. The goal is a working tool that can then be used and progressively developed. We seek a living, growing organism, not a closed, static data base.

In this sense the job can never be finished, but our results should be all the more valuable because of this trait.

The following paragraphs set forth a program for developing this information gathering capability, with example procedures.

Tentative Work Schedule

A comprehensive survey of sources of information and their subsequent development into the proposed system for information treatment will involve several steps. These are listed below in terms of approximate sequence, and type of personnel who would be the principal participants.

Professional Personnel	Clerical Personnel
1. Preliminary survey of information sources	
3. Preparation of formulas	2. Full survey of information sources
4. Preparation of computation routines	5. Ongoing assembly, punching, and verification of data
6. Ongoing experimentation and development	

Procedures for Collection of Information

The preliminary and full surveys of information sources will be described here in terms of the forms to be used for these surveys and in terms of example dimensions, domains, and partitions.

Forms for the preliminary information survey are as follows:

1. Source List (see Exhibit 1)
2. Catalog of Content Types (see Exhibit 2)

3 Simplified Catalog of Domains (see Exhibit 3)

4. Simplified Catalog of Partitions (see Exhibit 4)

5. Preliminary Source Survey (see Exhibit 5)

Source Number	Title	Location
1	Projections to the Years 1976 and 2000: Economic Growth, Population, Labor Force and Leisure, and Transportation. Outdoor Recreation Review Commission Study Report 23, 1962.	ISVD/CSED Library (30-30-43-F)
2	America's Industrial and Occupational Manpower Requirements, etc.	

Exhibit 1

Example Form for Source List (for both preliminary and full surveys)

In the Source List of Exhibit 1, each source of information is assigned a number, identified by title, etc., and the location of a copy of the source is indicated. In the example shown above, a library number related to the project collection is used.

Form of Contents	Serial Number (Content type)	Description
Q	1	Population (persons)
Q	2	Population (households)
q	1	Proportion of population (persons)
R	1	Annual rate of change of family income
q	2	Proportion of total income

Exhibit 2

Example Form for Catalog of Content Categories

(for both preliminary and full surveys)

A Catalog of Content Categories (Exhibit 2) is needed to keep track of the quantities that are being included as content dimensions, to insure consistency of notation and to avoid repetition. Designation of the form of the contents here is consistent with the scheme suggested earlier in this paper (i.e., Q for total quantities, q for fractions of the whole, etc.). The serial number specifies to what type of information the content refers. There need be no system to the assignment of serial numbers, since they are used for identification only.

Domain Number	Description
A1	All ages
L1	All locations including armed forces overseas
L2	All locations, not including armed forces overseas
I1	All industries
I2	All manufacturing industries

Exhibit 3

Example Form for Simplified Catalog of Domains

Domains, as suggested in Exhibit 3, will be identified by a letter code, indicating dimension, and a serial number. Again there need be no system to the assignment of serial numbers. Likely codes for the various dimensions are:

A : Age

I : Industry

Ø : Occupation

L : Location

E : Earnings

T : Time

Partition Number	Description
A 10	No partitioning of A1
A 11	Partition of A1 in 5 year segments
L 20	No partitioning of L2
L 21	Partition of L2 by states
I 10	No partitioning of I1

(Continued on next page)

Partition Number	Description
I 11	Partition of I1 by 2 digit SIC Categories
I 12	Partition of I1 by 1 digit 1960 census categories
0 10	No partitioning of 01
0 11	Partition of 01 by 1 digit 1960 census categories
0 12	Partition of 01 by 2 digit 1960 census categories

Exhibit 4

Example Form for Simplified Catalog of Partitions

The letter and first digit of the partition code (Exhibit 4) are the same as for the domain that includes the partition. The code "O" will be used to mean no partition of the domain. Catalogs of domains and partitions used with the full, detailed source survey will be similar, but stated with greater precision and detail.

Source	Pages	Content Types	Domain Types	Partition Types
1	17-34,	Q_1, Q_2, Q_4,	A1,6,5	A11,12,61,50,52
	50,72-91,	S_1,	L2,9	L20,95
	112-114,	R_5,	01,2	010,21,22
	125,127,	q_1,q_2,q_6	I1	I10,11,12
	129			

Exhibit 5

Example Form for Preliminary Source Survey

The Preliminary Source Survey (Exhibit 5) summarizes in non-detailed form the contents of the listed information sources. The purpose is to give a concise survey of the contents and the partitioning of the information in each source. These surveys will be used as a reference in making the full source survey, in preparing for computations, and in locating deficiencies in the information supply. Domain types and partition types need not both be given on the source survey sheet.

For the full survey of information sources, to follow and elaborate on the preliminary survey, the following forms will be used:

1. Source List (same as for the preliminary survey, see Exhibit 1)
2. Catalog of Content Types (same as for the preliminary survey, see Exhibit 2)
3. Full Catalog of Domains (like that for the preliminary survey, but expressed in more detail and with more precision, see Exhibit 3)
4. Full Catalog of Partitions (like that for the preliminary survey, but expressed in more detail and with more precision, see Exhibit 4)
5. Full Source Survey (see Exhibit 6)
6. Survey Record (see Exhibit 7)

Source	Item Number	Content Type	Units	Domain	Partition
1	1	Q1	Thousands of persons	A1, L1, 01, I2	A11, L10, 011, I20
1	2	Q2	Thousands of households	A1, L2, 01, I2,	A11, L21, 011, I23

Exhibit 6

Example Form for Full Source Survey

The form for the Full Source Survey (Exhibit 6) is similar to that of Exhibit 5 for the Preliminary Source Survey, except in the following points:

1. Each occurrence of information is listed separately.
2. Full information about the domain and partition of each occurrence is given.
3. Units in which the information is expressed are specified.

Source	Item Numbers	Pages Checked	Completion
1	1-10	1-50, 75, 81-93	All tables, pages 1-5, those marked on other pages
2	1-14	All	All tables included
3		All	This source contains no relevant information

Exhibit 7

Example of Survey Record

The Survey Record (Exhibit 7) serves to record the degree to which each source has been canvassed by the Full Source Survey. The pages in the source which have been reviewed are indicated, along with the items that have been collected from these pages. A statement of the degree to which the source has been examined and to which its contents have been noted is also given. A similar form could apply later on to the coding and punching of information.

The most frequently occurring dimensions will probably be location, occupation, and industry. A sampling of some of the domains and partitions of these dimensions likely to be used is shown below.

Location

Domains	Partitions
Full United States	By Region
New England	By State
Massachusetts	By County

Occupations

Domains	Partitions
All	Dictionary of Occupational Titles
All Civilian	U.S. Census 1950, 1 digit
Professional	U.S. Census 1950, 2 digits
Engineering	U.S. Census 1960, 1 digit
Skilled	U.S. Census 1960, 2 digits

Industries

Domains

- All
- All Manufacturing
- All non-Farm
- All Service

Partitions

- Standard Industrial Classification
- U.S. Census 1950, 1 digit
- U.S. Census 1960, 1 digit
- U.S. Census 1950, 2 digits
- U.S. Census 1960, 2 digits
- Dictionary of Occupational Titles

Many small variations in partitions will occur, and for proper processing must be made compatible or included in separate listings, whichever is appropriate.

Preparation of Formulas and Routines for Computation

The information collection procedures outlined earlier are the first step in combining the contents of individual sources of information to make a whole that is greater, in terms of the understanding it provides, than the sum of its parts. To this general end the following must be possible with regard to whatever information is collected:

a) to fill gaps in individual content categories through

- interpolation
- extrapolation

b) to condense and summarize information about individual content categories through

- averaging
- summing

c) to establish relationships among content categories in order to help fill gaps and to construct whatever new categories may prove useful

Additional computational capabilities that should also be included are:

- Statistical procedures to suitably combine conflicting or overlapping information
- Translation among partitions or domains
- Discounting procedures
- Normalization to satisfy constraints
- Derivation of new partitions from sets of old partitions
- Projections in terms of expected effects (e.g., technological change,urbanization) as a modification to purely extrapolative methods.

To illustrate that this prospectus includes within it the capabilities that have already been proposed, the methods of Reference 1, the first ISVD technical paper on forecasting, are shown schematically below in terms of the content categories discussed here.

Method 1

$$\begin{tikzcd}
\boxed{Q_1(1966)} \arrow[r] & \boxed{Q_1(1980)}
\end{tikzcd}$$

where Q_1 is employment specified by industry and occupation.

The above diagram indicates direct translation from 1966 to 1980 without use of further information. The equality relation in Reference 1 is a special case of this.

Method 2

$$\begin{tikzcd}
\boxed{Q_1(1966)} \arrow[r] \arrow[d] & \boxed{Q_2(1966)} \arrow[r] & \boxed{Q_2(1980)} \\
\boxed{q_1(1966)} \arrow[rr] & & \boxed{Q_1(1980)}
\end{tikzcd}$$

where the newly introduced quantities are defined as follows.

Q_2 is total employment

q_1 is distribution of employment among occupations and industries.

Method 2A

$$\begin{tikzcd}
\boxed{Q_3(1966)} \arrow[r] & \boxed{Q_3(1980)} \arrow[dr] & \\
& & \boxed{Q_5(1980)} \\
\boxed{Q_4(1966)} \arrow[r] & \boxed{Q_4(1980)} \arrow[ur] &
\end{tikzcd}$$

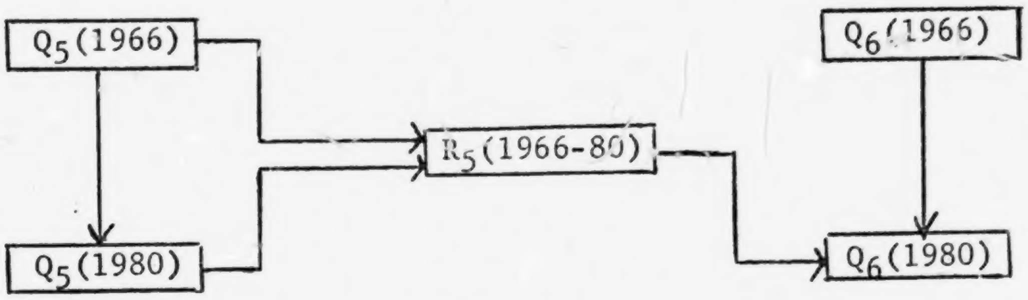
where the newly introduced quantities are defined as follows.

Q_3 is output by industry

Q_4 is output per worker

Q_5 is employment by industry.

Method 2B

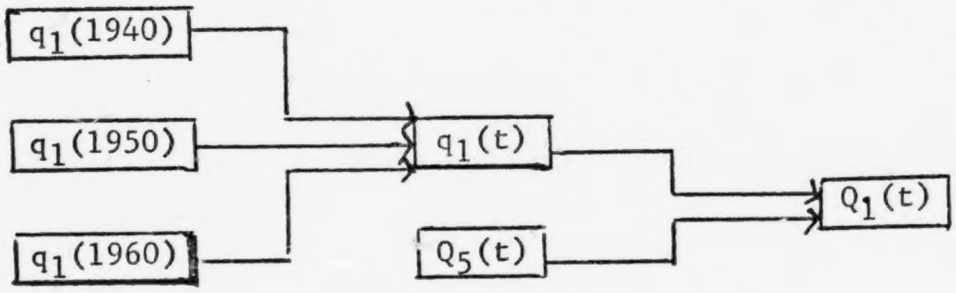

$Q_5(1966)$
$Q_5(1980)$
$R_5(1966-80)$
$Q_6(1966)$
$Q_6(1980)$

where the newly introduced quantities are defined as follows.

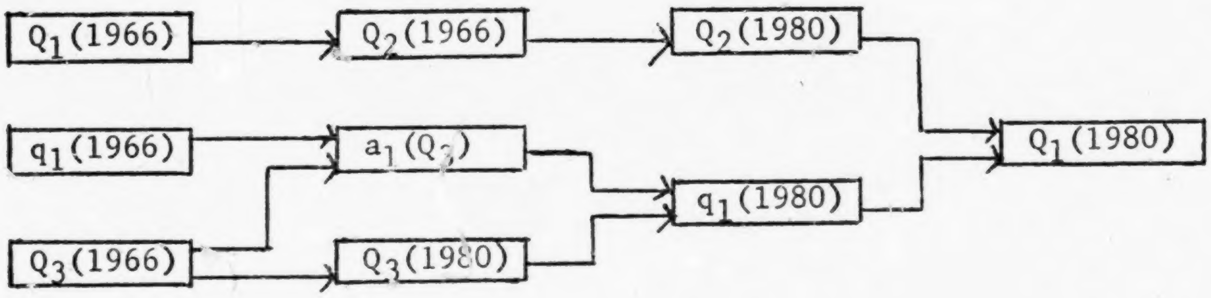
R_5 is rate of growth 1966-80, nationally

Q_6 is regional or local employment by industry

Method 3A


$q_1(1940)$
$q_1(1950)$
$q_1(1960)$
$q_1(t)$
$Q_5(t)$
$Q_1(t)$

Method 3B



where like industries are grouped together, and

a_1 is a coefficient relating employment mix and output within each group of similar industries.

Methods 4 and 5 are examples of adjustment or normalization of forecasts in terms of the results of other, related forecasts. They will not be discussed further here.

A comprehensive set of relations and formulas must be compiled and checked out, sometimes with alternate formulas for a given purpose. A list of these formulas will then be prepared, along with a body of rules for their use, including:

- terms and conditions of use
- form and type of input information needed
- form, nature, and possible use of the output, including an evaluation of its likely quality (e.g., accuracy, bias).

On this base a set of computer routines will be developed, to eventually constitute a specialized computer language to handle occupational and industrial forecasts.

To test and use this information system, not all available data would be introduced at once. It would be coded in stages, as needed, and these would become part of the total supply of coded input data, to be combined and experimented with on an ongoing basis.

The following points, while not central to the above discussion, should also be kept in mind:

- We will want to allow for and include non-quantitative information, not for computation but for simple storage and recall.
- There should be a special information gathering and treatment program for short term information, using as sources
  - Job orders and similar local sources,
  - Newspaper advertisements,
  - Bureau of employment security materials,
  - Employment/unemployment figures.
- Computer output should be made to include statements of sources, of input quantities used, and of formulas used, to aid in checking the results.
- Computer output should indicate the information gaps found in trying to do computations, as an alert that these gaps will need to be filled.

There will be many lessons learned as the procedures suggested here are put to practical use. The present discussion is meant to be a point of departure, and should in no way limit the range or scope of future activity. Some important possible extensions of capability in forecasting are mentioned at the end of Reference 1. Of the many possible directions that this work can legitimately take, the most easy to attain generally should be undertaken first. The more difficult ones will come after a foundation has been laid and the details of the procedures and analysis are better understood.

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This list is meant to be suggestive only, and is in no way closed or restrictive.

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INFORMATION SYSTEM FOR VOCATIONAL DECISIONS

Project Report No. 8

TOWARD A LANGUAGE OF SUPERVISION

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TOWARD A LANGUAGE OF SUPERVISION

A Project Report

> "... if it is true that the self or subject of experience is part and parcel of the course of events, it follows that the self becomes a _knower_. It becomes a mind in virtue of a distinctive way of partaking in the course of events...The change made in things by the self in knowing is not immediate and, so to say, cross-sectional. It is longitudinal--in the redirection given to changes already going on."
>
> Dewey, John. "_Essays in Experimental Logic_," pp. 62-63

Wallace J. Fletcher, Principal Investigator
Lawrence Lerer, Research Associate
Charles Gunnoe, Research Assistant

Introduction

A meaningful discussion of the role of supervision within the Information System for Vocational Decisions requires that one first gain a clear understanding of the role of ISVD within the "process of education."

The Project is designed to create a computer-based information system for vocational decisions having as a facilitory unit of operation the client-machine interaction. This computer-based system will have two primary functions. Within the first function, relevant career development data/information will be provided to the client via data bases dealing with "the world of work," the client, and the "world of education."

The second primary function of the system will be to assist the client in promoting a sense of responsibility for his own career development, more specifically, a "sense of agency" regarding the decisions he makes and a "sense of purposing" guiding those decisions. The theoretical concerns manifested in this second function determine the form and content of the information-giving function of ISVD and the processes of articulation of the System with the educational structure.

The Decision-Making Paradigm: Discontinuities as Problems and Behavior Anticipatory to Choice

Tiedeman and O'Hara[1] have elaborated a schema which allows one to put career development into an analysable perspective; analysable for the investigator and client alike. When users elect to learn the dynamics of this process of analysis of their experiences, they participate in a valuable experience, one that is dynamic.

The mechanism of career development is the process of differentiation and integration. "Career development is conceived as the process of fashioning a vocational identity through differentiation and integration of the personality as one confronts the problem of work in living." For a system to facilitate this, there is need to further illuminate the subtleties of this process; illumination appearing in the form of a decision-making paradigm.

Implicit in this paradigm is the belief that differentiation and integration occur through the experiencing of problems, and decisions made in their solutions. This process becomes most significant when the person engages in it rationally. Thus, the decision-making paradigm describes a rational mode of problem-solving as it applies to career development. According to this paradigm, one experiences a problem, anticipates and makes a decision about it, implements this decision and finally accommodates to it in one way or another.

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[1] Tiedeman, D. V., and O'Hara, R. P., Career Development: Choice and Adjustment. College Entrance Examination Board, New York, New York, 1963.

[2] Ibid., p. V.

When considering vocational behavior (or any other area of behavior) of an individual, one focuses upon a series of discontinuities through which this person passes. Only some of these discontinuities were within his cognizance as problems and have been dealt with as such. To perfect the rationality of dealing with his discontinuities, a person must first learn to recognize the discontinuity as a problem.

It is recognition that these discontinuities are problems which provides the subject matter for the Tiedeman-Field paradigm of purposeful action. If, as Tiedeman believes, "career is the imposition of direction into the vocational behavior of a person which is subject to his comprehension and will,"[3] then the development within the person of goals which provide him with a problem-solving perspective is necessary in recognizing discontinuities as problems. The "purposing" of behavior becomes operational only when the "currently desired" becomes part of the consciousness of the individual. To define more accurately the problem, the person must evaluate the "currently experienced" recognizing that his move to the "currently desired" involves risk-taking on his part--be it time, energy, self-respect, money or whatever.

This risk-taking introduces another concept into the first stage of the decision-making paradigm. This ability to become a risk-bearing participant in the decision-making process is called by Fletcher "entrepreneurial behavior."[4] While the degree to which risk is brought to any behavior manifested by the individual affects the very kinds of discontinuities he will perceive as problems, it also affects his efforts in decision-making at other stages in this paradigm.

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[3] Tiedeman, D. V. Theory underlying lecture on "Occupational Guidance and Vocational-Technical Education" at Conference on Education and Productive Society, Department of Industrial and Vocational Education, Faculty of Education, University of Alberta, Edmonton, Canada, 1964. Mimeo p. 45.

The second stage of the decision-making paradigm concerns a person's behavior prior to making a choice. This anticipatory behavior is divided into the stages of exploration and crystallization, followed by choice and choice clarification. Important aspects of anticipatory and choice behavior involve the elaboration and subsequent narrowing of goals and alternatives, while moving through the various stages.

Changes in the psychological condition of the person occur as problems of importance are resolved. Therefore, at each stage different kinds of information, in a variety of forms, become optimally relevant to the individual. It is the realization of the significance of this implication which allows us to discuss some of the more specific aspects of the supervisory component of ISVD.

Inherent in the process of vocation and career development as noted in the above described decision-making process is progress from a present condition (known or unknown) to a future condition (anticipated or unanticipated), e.g., "transition through discontinuity." Despite the fact that the current state of the client is transitional, he is at some point in the above described decision-making paradigm--exploration, crystallization, choice, clarification--in becoming a "knower."

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[4] Dudley, G. A., and Fletcher, W. J., "Personally Determined Career and Entrepreneurial Behavior: Notes and Comments on a Dialogue." Harvard Studies in Career and Entrepreneurial Behavior: Notes and Comments on a Dialogue." Harvard Studies in Career Development No. 41, August 1965.

As we examine the occupation, education, military, marriage and leisure "life lines" of an individual, it becomes increasingly apparent that at no time are each of these in stasis. It is essential that this dynamic consciously be understood and identified by the client as he elects to develop his "life style." It is in this developmental process that the supervisory mode of ISVD is the essential component, and is defined as the continuous active management (administration) of the problem-solving decision-making processes.

The Decision-Making Paradigm: Implications for Supervision

The critical aspects of this process of cooperative management suggest for the supervisor:

A. Accurate Identification of the Elements of the Decision-Making Problem-Solving Model.

The supervisor must recognize the interrelations of the separate life line elements of the individual client, so that he and the client can better understand the interrelationships among the discontinuities occuring within and/or between each of these elements.

Decision-making is an on-going process involving continuous "review" of each phase.

B. Changes Which Occur Among and Between the Elements Noted in Decision-Making Must Become Explicit to the Client and Supervisor.

The client is always at various points in the decision-making process within the context of each of his particular life lines.

Therefore, it becomes incumbent upon the supervisor that he so stimulate the client that they cooperatively will engage in those problem-solving procedures that will generate understandings to assist in the identification of discontinuities in each of the clients' life lines. Following this, the supervisor assists the client to establish understandings, on a time and order scale, of the intimate relationships among the discontinuities, the quality of the action to be taken, and the creation of an order of priorities in successfully passing through each discontinuity. Therefore, there must occur:

C. Continuous Identification and Evaluation of the Outcomes of the Above Described Processes With an Appraisal of the Degree to Which Desired Goals Have Been Established and/or Reached.

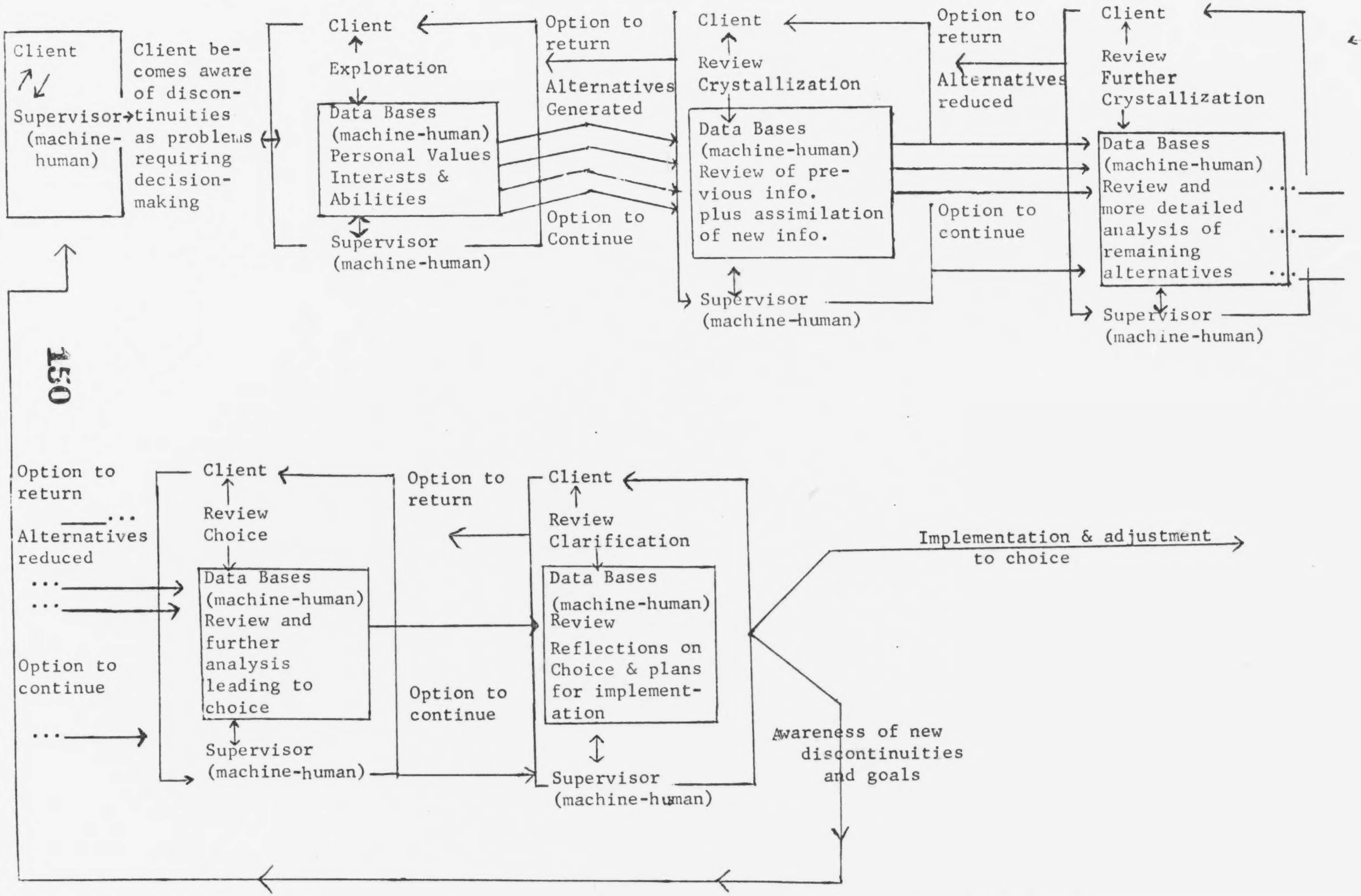
Theoretically, the supervisor and the client have been continuously exploring alternatives utilizing the environmental and/or personal data recorded in the machine--human components of the "System" as well as the expressed value system of the client. A product of this exploratory activity is the selection of alternatives for further examination. Then the supervisor, with the client, re-examines previous data (review) and explores new data which are applied to limited alternatives. This process continues, choices are narrowed until the client feels comfortable with the final selection of a choice. This selection of alternatives with respect to specific activity goals is facilitated by the rational decision-making process. It must be emphasized that during the above described process the supervisor serves as an active participant. (Figure 1)

The Decision-Making Paradigm: Accomodation and Adjustment to Decisions

So far we have discussed the first two stages of the decision-

Figure 1

CLIENT-SUPERVISOR-DATA BASE RELATIONSHIPS


Client
Supervisor
(machine-human)
Client becomes aware of discontinuities as problems requiring decision-making
Client
Exploration
Data Bases (machine-human) Personal Values Interests & Abilities
Supervisor (machine-human)
Option to return
Alternatives Generated
Option to Continue
Client
Review Crystallization
Data Bases (machine-human) Review of previous info. plus assimilation of new info.
Supervisor (machine-human)
Option to return
Alternatives reduced
Option to continue
Client
Review Further Crystallization
Data Bases (machine-human) Review and more detailed analysis of remaining alternatives
Supervisor (machine-human)
Option to return
Alternatives reduced
Option to continue
Client
Review Choice
Data Bases (machine-human) Review and further analysis leading to choice
Supervisor (machine-human)
Option to return
Option to continue
Client
Review Clarification
Data Bases (machine-human) Review Reflections on Choice & plans for implementation
Supervisor (machine-human)
Implementation & adjustment to choice
Awareness of new discontinuities and goals

making-paradigm: experiencing a discontinuity and making a decision about it. Let us now direct our attention to the third stage of the decision-making paradigm; the implementation of, and adjustment to, the decision made, involving induction, reformation and integration.

In this phase, "The individual field organized by the person's goal comes into operating interaction with society's (for example, school's or employer's) related but not identical goal and field."[5] It is apparent then that during this phase, the individual will be engaged in some kind of group, collaborative activity. Induction occurs when the goals and reveries of the individual interact with those of society. The primary orientation of the person is a receptive one.

As this receptive mode changes to an assertive one, the person enters reformation. Having been accepted by the group as a participant in goal achievement, the individual then attempts to bring the group not only closer to its goal but also into greater conformance with _his_ growing sense of identity. As the person effects a synthesis of his own goals with those of the more established members, he begins to function in the integrative phase.[6] The identity of the person in this phase is influenced by the group goals while at the same time affects the development and implementation of these goals.

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[5] Tiedeman, D. V. and O'Hara, R. P., op. cit., p. 43.

[6] This pattern closely resembles the theory of "Interpersonal Behavior" of William C. Schutz who uses the terms "inclusion," "control," "affection," to describe interpersonal relations in a small group.

Ideally this integration occurs between the relatively confident identity of the individual and that of the group resulting in a series of compromises which facilitate the attainment of a goal and are neither destructive nor threatening to either element. If the individual believes these compromises to be overly threatening to his growing sense of identity, he may decide to abandon this particular group and their goals and/or find another group with similar goals whose methods of attaining these are more consistent with his own.

Role Acquisition: The Realization of Relationships

As the concept of differentiation and integration in the decision-making paradigm clarifies dynamic issues in the process of career development, so too does the concept of role acquisition help formulate relevant issues to the client as he works through the paradigm. It is posited that one can view attainment, or partial attainment, of goals as the assumption or acquisition of a role or set of roles. A person entering the decision-making mode adopts consciously or unconsciously means of achieving desired goals. This "modus operandi" takes the form of "coping strategies." These coping strategies determine the balance existing among the elements of entrepreneurial behavior, the priority established for achieving desired outcomes, and the methods of evaluating and processing information. The concept of role acquisition involves not only the selection of various coping strategies, but also the more general issues of the "life styles" of people seeking similar goals, and the relevance to the individual of previously achieved or attempted role acquisitions.

The judgments which an individual makes regarding the desirability of prospective life styles are a function in part of the conceptions he has of himself. Therefore, the more realistic and conscious his awareness is of himself, the more rational his judgments will be. It is also essential that he have opportunities to test the validity of these self concepts against objective measures of these aspects. Facilitating this is clearly the responsibility of the supervisor, indicating a need to examine in detail the assumption of appropriate role activity by an individual.

The first phase involves role perception. During this phase the individual begins to realize some of the implications (actual or imagined) of his various decisions. He begins to become aware of the interrelations among his various goals and the effects these may have on different aspects of his life. The individual sees a goal not as the end of a series of discrete discontinuities, but as a more or less complex pattern of interests, aptitudes and values. The degree to which he is impressed with his perception of the pattern which a certain role implies will influence his motivation for further scrutiny of it. The degree to which his perceptions agree with more objective perceptions of the role will determine the amount of re-learning he will probably need to affect during the next phase. Since there is the possibility of re-learning, one should not label all reverie as inappropriate activity.

If the person is engaged by the perception he has gleaned of a certain role, he is likely to move into the phase of role activity. Interaction with his supervisor leads to active involvement in those processes which the actual "consensually validated" role entails. It is incumbent upon the supervisor to ensure that the client takes active initiative in response to as many individual components of the role as possible. Through this the client tests his perceptions against more objective criteria. It is suggested that testing of this sort occur through simulated role activity; e.g., games,[7] and cooperative work/study experiences.

After the testing and evaluating of this activity phase prove sufficiently positive, the individual moves into the stage of role identification. Here he begins to internalize, making part of his "apperceptive mass"[8] "preconscious,"[9] many of the understandings he has gained from the previous two stages.

In Polanyi's terms he has gained a "tacit" understanding of the role and incorporates this role as one dynamic aspect of his total life style. For example, rather than considering himself a scientist, he might better say that he is "sciencing." As Polanyi says: " ...it is not by looking at things but by dwelling in them that we understand their joint meaning."[10]

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[7] A game may be defined as any contest (play) among adversaries (players) operating under constraints (rules) for an objective (winning, victory, or payoff).....They always have the characteristics of reciprocal actions and reactions among at least partly independent entities having different objectives. Clark C. Abt, Games for Learning. Educational Services Incorporated, 1966, p. 5.

[8] Herbart, Johann, F., Outlines of Educational Doctrine, New York: MacMillan Co., 1901.

[9] Kubie, Lawrence, Neurotic Distortion of the Creative Process, University of Kansas Press, 1958.

[10] Polanyi, Michael. The Tacit Dimension. Doubleday and Co., Inc., Garden City, New York, 1966, p. 18.

At this stage simulation is valuable with regard to specific problems. However, complete role identification cannot occur within the context of a simulated situation; real life experiences are essential in effecting this transformation...experiences which the supervisor plans with and for the individual.

The highly idiosyncratic nature of the process of role identification gives added emphasis to the validity of experiences. While the process of role acquisition is occurring there is simultaneous activity patterned after the decision-making paradigm of differentiation and integration. The interplay between the processes of role acquisition and differentiation and integration have significant mutual interaction. But perhaps the most significant influences will be those which role acquisition has upon differentiation and integration. The roles a person has acquired or partially acquired, and the understandings he has gained through these experiences, alter his perceptions of the kinds of discontinuities he sees as problems. These previous role experiences affect the new roles the individual perceives and his degree of sophistication in acquiring each particular new role. Concerning this latter point, the important understanding is that after a person has engaged in any role acquisition he will have at his disposal information which will allow him to enter a new role activity process with a broadened experiential backlog of information. This may be information of an explicit nature or part of the individual's "tacit dimension."

As does Polanyi, we too assume that without necessarily understanding all the individual components, the client gains the "essences" of the role. The degree to which these essences are internalized by the client determines the degree to which "role identification" occurs. The client continues in the decision-making paradigm with a new perspective and again the supervisor focuses upon "walking the client" through this process. Alternatives are differentiated; integration among relevant elements within these alternatives occurs. As these relevant elements are sorted out and new alternatives selected, the client moves from exploration to crystallization to choice in relation to the responsibilities involved in new role activities.

On this spiral-like path through the above described processes, the client takes with him a residue of essences usable in developing understandings about future role perceptions, role activities, and role identification.

It is within a context of the critical aspects noted above that the supervisor stimulates activity and develops a base upon which with the client he creates the circumstances within which the client comes to view himself as the problem-solver, decision-maker. Thus is established a readiness for the components of the Think-Act duality.

Summary:

From the theoretical point of view which has been discussed, one realizes that a computer-based system which provides information to a client is not an autonomous entity. A machine-client interaction must be an integral part of the more general educational and social framework within which clients function. This framework prepares the client for the client-machine interaction and suggests an appropriate range of experiences necessary for a particular stage of career development subsequent to this interaction. Even within the client-machine interaction it is necessary to use information from sources which precede the machine experience and from the experience itself as it is occurring. The job of describing, effecting, and evaluating these articulations will be the subject of future statements. At this point, and with regard to future statements it is imperative we consider certain key concepts.

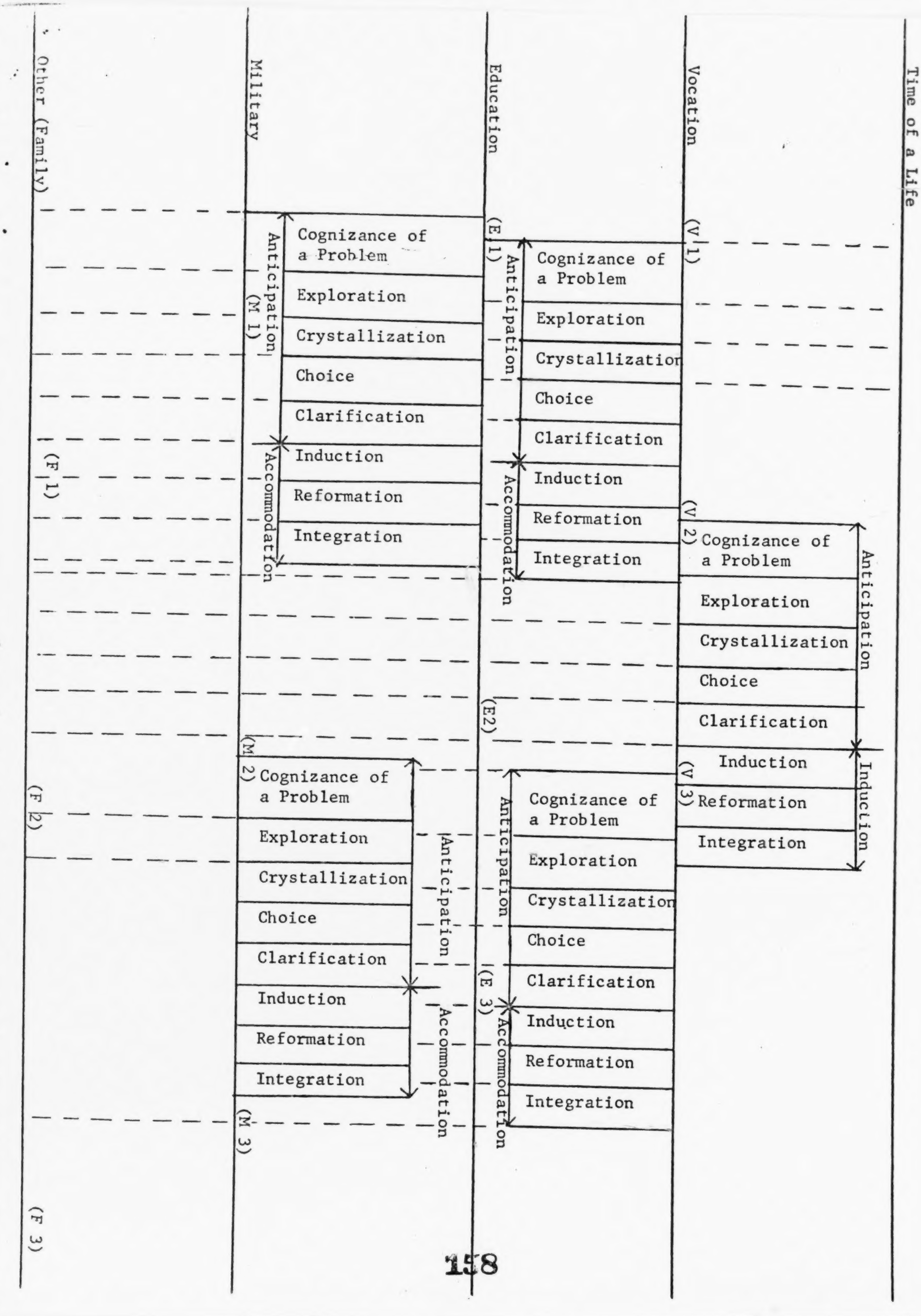
The supervisor facilitates within the client the development and utilization of an increasing apperceptive mass of essences permitting passage through the processes of perception, activity and identification in his current role.

It is incumbent upon the supervisor that he understand the environmental and personal data relevant for each individual client so that passivity and accidental role acquisition is minimized. Selection of the appropriate modality by which these data are made available to the client through interaction with other human and/or mechanized components of the system is, of course, a prime responsibility of the supervisor.

The goals of the project have been stated within the framework of the previous theoretical discussion. These theoretical constructs provide the framework needed for the supervisory mode to attain these goals. These constructs provide a perspective within which to view the supervision of career development and develop a language to describe it.

Of the possible categories we could use to organize and implement the supervision of career development, we will rely on the previously

Figure 2 - INTERRELATIONSHIPS OF DISCONTINUITIES


Time of a Life
Vocation
Education
Military
Other (Family)
(V 1)
(V 2)
(V 3)
(E 1)
(E2)
(E 3)
(M 1)
(M 2)
(M 3)
(F 1)
(F 2)
(F 3)
Anticipation
Accommodation
Induction
Cognizance of a Problem
Exploration
Crystallization
Choice
Clarification
Induction
Reformation
Integration

discussed heuristic concepts:

1. Differentiation and Integration.
2. Career development as a series of discontinuities.
3. The Decision-Making paradigm as a description of a rational mode of problem-solving with regard to career development.
4. Paradigm of purposeful action.
5. Entrepreneurial behavior as a basic coping strategy.
6. The process of role acquisition (perception, activity, identification).

These concepts are related graphically by an adaptation of Tiedeman's life-line and decision-making paradigms. (Figure 2)

For example, within the vocational life-line there occur a series of discontinuities (V1, V2, V3). Each discontinuity is conceived of as a decision-making point, which to be experienced most rationally, will follow the decision-making paradigm. An examination of Figure 2 indicates that the "accommodation" phase of V1 falls into the same period of time as the "anticipation" phase of V2. It is also apparent that the "anticipation" phase of V1 falls into the same period of time as the "anticipation" and "accommodation" phases of E2. Therefore, the "coping strategies" used in relation to discontinuities within a single life-line affect not only each other, but also "coping strategies" in the other indicated life-lines.

The successive differentiation and integration which one goes through in any of his life lines will be most satisfactory to the individual if he has a sense of purposing to guide these and the ability to accept risk and become an entrepreneur...a sense of purposing given direction and guidance growing out of joint supervisor-client relationship.

Role acquisition provides us with a concept which, for both the client and the supervisor, allows an organization of activity in each of the life lines toward a goal more general than the working through of separate discontinuities. The higher order construct will hopefully provide the kind of generalizing perspective necessary for the perception of the relationships which exist among a variety of vocational activities.

Given the preceeding analysis and definition of the "supervisory component," it is now appropriate to attempt, in a subsequent report, a preliminary assignment of responsibilities of this component between the extrinsic and intrinsic supervisory elements of ISVD.

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INFORMATION SYSTEM FOR VOCATIONAL DECISIONS

Project Report No. 9

PROSPECTS FOR TECHNOLOGY AND COMMERCE IN THE MEDIATION OF VOCATIONAL DEVELOPMENT FOR VOCATIONAL MATURITY

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and

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May, 1967

Recent Developments and Current Prospects in Occupational Fact Mediation

Outline

I. The subsumption of media by mediation

  A. From media to mediation
  B. Epistemology and pedagogy in mediation

II. Vocational development as goal of occupational information mediation

  A. Vocational development
  B. Vocational choice
  C. Vocational self concept and career in personality
  D. Vocational maturation: a new goal in occupational fact mediation

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  B. Personal responsibility and pedagogy
  C. Guidance in education and vocational maturity
  D. A structure of educational authority appropriate for vocational maturation

IV. Prospects for technology and commerce in the mediation of vocational development for vocational maturity

  A. From theory to technology in mediation
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  C. A structure for mediation of vocational maturation in the ISVD

V. An economy for mediation of occupational facts: the counselor and his mediation of vocational maturation

  A. Summary and challenge
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Appendix A. A partial inventory of developments in mediation in which the media are themselves the things

Appendix B. A computer-based Information System for Vocational Decisions

Appendix C. Prospects in mediation: commerce in mediation

References

Recent Developments and Current Prospects in Occupational Fact Mediation[1]

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The Subsumption of Media by Mediation

From Media to Mediation. Our Conference host, David Pritchard, originally invited Tiedeman to report on recent media developments associated with the presentation of occupational information. He demurred from Pritchard's initial suggestion, however, because, upon hearing it, he realized more clearly that mediation, not media, is the central focus for education. The turning of occupational facts/data[2] into information is a personal and educational process. Therefore, the important question in relation to media in occupational information is the means by which media actually prove to mediate the personal educational process. We elect to address herein the most important of our questions in vocational guidance; namely, how may we better the personal educational process associated with vocational development?

Shortly after Tiedeman's conversation with Pritchard, he had a confirming experience with a recent book by McLuhan and Fiore. The younger of his sons left his copy of this book on a table in their living room for about a week but he was not particularly interested in it because, during his early glances at it, he kept reading its title as *The Medium is the (Message)*. That seemed a clever, though not an intriguing, title. One day it suddenly came to him that the book's title is actually *The Medium is the Massage* (McLuhan and Fiore, 1967), not the Message. His double take and that realization connected then with his realization that he had agreed to speak to you on mediation. Thus, a hurried turn to the book reinforced his recognition that, in occupational information as well as in the generality of communication treated by McLuhan and Fiore, the media are not the message. In fact, media can never be the message; only the facts which media convey are the message. The media themselves only become important in message transmission when they actually mediate transmission - when they actually massage the occupational information process as persons are exposed to occupational facts/data.

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[1] Speech, National Conference on Occupational Information in Vocational Guidance sponsored by the U.S. Office of Education, Chicago, Illinois, 17 May 1967.

[2] Occupational facts/data come in two conditions, fixed and modifiable. We therefore elect to adopt the cumbersome term,"facts/data", to indicate this fact throughout the paper. Occupational facts are directly recoverable without mediation except for storage and later recovery. On the other hand, occupational data must be additionally processed by the numeric and/or linguistic routines of a mediation system.

Epistemology and Pedagogy in Mediation. We introduce these experiences of Tiedeman's, namely those with David Pritchard's initial invitation and with the McLuhan and Fiore book, in order to place our report on recent media developments within a conceptual framework on which we had both been previously working independently but now find that we can herein express collaboratively. We feel that our new common framework is of considerable importance in determining the significance of current work in media development. Why?

The point of view we outline in this paper is one which derives important aspects of its validity from being realized again and again through a wide range of personal experiences with facts and ideas. We try today to give you that important personal experience of discovery, insight, and acquisition because you can if you try really understand yourself as a process. Our "frame of reference" with regard to the interplay of facts, ideas, purposes, and action represents what we understand Polanyi to mean when he speaks of personal knowledge; that is, a form of orientation which, while it cannot be specified in the abstract, serves in any given context of personal encounter to articulate immediate concerns with issues of broader relationship and relevance (Polanyi, 1958). Therefore, in order to articulate aspects of our immediate topic within a context of issues of broader educational concern, we shall address ourselves herein to two assumptions which we consider implicit to much of the work in this field today - assumptions which, however, we consider to be inconsistent both with crucial principles of educational process and with the rationale of one of the developments to be reported, namely, the Information System for Vocational Decisions (hereafter ISVD) project.[3] We state these assumptions now so that we may substitute in later sections their inconsistency both with present work and with the ISVD. It is the alternatives to these principles that you will find us building into the ISVD.

The first of these assumptions pertains to the nature of knowing and the known. There are current applications of recent media developments to issues of vocational information which appear to presume that facts, data, or information consist of bits of knowledge which correspond directly to that presumed to be the real, the true and the knowable. In brief, knowing and the known are presumed by these efforts to comprise a direct, linear relationship, both in the abstract and as we realize them as dimensions of particular circumstances. An acceptance of this assumption invokes an epistemology stemming from the great English Empiricists, Hobbes, Locke, and Hume and in our sciences finds perhaps its most thoroughgoing implementation through the rationale and methods of those guided by logical positivism. It represents, however, a position of which we shall show the serious limitations as we attempt to implement our current technological resources in the service of personally-determined career development.

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[3] Principal Investigators in the Information System for Vocational Decisions are Russell Davis, Richard Durstine, Allan Ellis, Wallace Fletcher, Edward Landy, Robert O'Hara, David Tiedeman, and Michael Wilson.

The second of the assumptions is in an important sense subordinate to the first, for it pertains to the nature of the relationship between acts of knowing or learning and those of teaching or counseling. This assumption suggests that, on the basis of a "correspondence" theory of knowledge, we can presume to select those aspects of the known and knowable which shall be most effective in determining a subsequent course of events toward an end that we value and which, as "means" toward that end, we call "learning." In brief, the assumption here is that we can determine, in advance, both goals and procedures appropriate to the educational process in its distinctive human immediacy and variability.

These two assumptions, one "epistemological," and the other "pedalogical," are inconsistent with what seems to be one of the most crucial principles of our own current work, namely, that both knowledge and the process of knowing are functions of a personal and collaborative context of exploration and confirmation - a context which is itself defined by a nexus of human purposes expressed both overtly and covertly, both tacitly and articulately. The alternative position from which we speak suggests that our talk about media cannot look in one direction only. It cannot look solely toward facts, data, information - in isolation from persons and processes. In short, we hold that the reciprocal interaction between the knower and known entails a "transactional" perspective and array of procedures more aptly denoted by the notion of mediation. The final turn of this argument is that, because of the interplay of the tacit and articulate dimensions of knowing in the personal act of learning, the experience of mediation is that of a massage. In other words, we inevitably encounter the new with a habitual tensing of our intellectual musculature, with the result that its meaning takes initial form after that which we have long known and accommodated ourselves to. Only after we have worked with (and perhaps more importantly still, been worked on by) a new possibility do we relax to the point of seeing more clearly that something new has indeed been going on in, as well as around, us /cf. Piaget (Flavell, 1963) on assimilation and accommodation7.

Our advocated perspective is "transactional" by virtue of the implication that both processes of teaching and learning are construed as individual and collaborative acts of "sampling", from among a wide range of on-going events (both personal and environmental), those configurations of meaning and implication which best serve to differentiate means and ends, processes of imagination and structures of knowledge, and acts of discovery and principles of verification. Within this "transactional" perspective facts, data, and information derive their significance as exemplifications of meaningful coherence among stable dimensions of events reflecting multiple principles of order (Neisser, 1963). It is this transactional perspective regarding the interplay of information and imagination which brings our ideas in harmony both with current developments in discovery teaching and the "new" curricula (Bruner, 1966) and with the "new" self-knowledge and creative learning developments (Kubie, 1958). It is, in sum, a point of view from which we risk inviting the student to take advantage of our capacity to learn through his ability to teach us.

You are provided in the handout a summary of recent media developments associated with the presentation of occupational information (see Appendix A). This is the particular summary which David Pritchard originally wanted us to provide. Therefore, we accommodate his need but by way of your later reading, not present listening.

We are now thereby free to devote the balance of our report to tracing the emergence and implications of our "transactional" or "mediating" perspective regarding those developments. This point of our view has never before been reported. In presenting our point of view for evaluating the application of media to issues of occupational information within the context of personally-determined career development, we shall stress three "facts," namely:

1. The subordination of the concept of media to the concept of

mediation implies that, in relation to occupational information, media represent means in the service of vocational development. Thus the first "fact" to be developed more fully is that of occupational mediation in relation to the cultivation of vocational development.

2. The concept of vocational development as the goal of occupational mediation raises the issue of personal responsibility and involvement in the determination of those ends. This is the second of the "facts" within the context of mediation to be considered.
3. Finally, a discussion of vocational development and occupational mediation within the context of formally organized educational structures raises issues with respect to broader implication and implementation. Thus the third "fact" to be discussed is our responsibility and opportunity to consider means by which mediation of vocational development can be more effectively accomplished for all citizens of the United States through the engagement of systems and structures beyond those formally organized for educational purposes.

Vocational Development as Goal of Occupational Information Mediation

Vocational Development. The past twenty years mark profound change in vocational psychology. Ginzberg and colleagues seemingly led us into this new era with their book on the process of occupational choice (Ginzberg, Ginsburg, Axelrad, and Herma, 1951).

Although the Ginzberg study received the most attention in the beginning, the study was itself also a part of an emerging elaboration of the concept of vocational development by Donald Super. Super began the incorporation of the psychology of adjustment into the psychology of vocational choice just prior to World War II. His consultation with his Columbia colleagues during the Ginzberg study seemingly helped him to crystallize this union of vocational choice and adjustment and to formulate that union in 1953 as a theory of vocational development (Super, 1953). Super followed his 1953 statement of vocational development theory by numerous papers, several monographs, and his book The Psychology of Careers (1957). Super's theory of vocational development is by now solidly foundational for practice.

Super's original basis and theory in vocational maturation is now also being consolidated and expanded by Crites (1965) who is developing an elaborate series of scales in vocational development and an extensive plan for further investigation of the possibility of turning vocational development into vocational maturation. Gribbons (1959) has also given us a scale of vocational readiness as a part of vocational development. Gribbons and Lohnes (1966) have also already theoretically and empirically linked several important vocational consequences to vocational readiness during the high school period of life.

Vocational Choice. These three lines of research in vocational development itself have been coincident with three sister lines of research in vocational choice. The research in vocational choice is characterized in its broadest outline by the work of:

1. Cooley who contributed his overlapping, longitudinal study (1963) of the development of scientific careers, Flanagan and Cooley (1966) who have carried on Cooley's initial efforts at prediction of educational and vocational choices in relation to the analysis of Project TALENT; and Shea (1964) who has carried on Stoffer's interest in educationally breaking the social inheritance of occupational behavior.
2. Roe (1956) who related categories of occupations to the variations of personality and intelligence in our society, Holland (1964) who extended that work and derived scales of personality which convey later membership in occupation to some extent, and Campbell (e.g. Campbell and Johansson, 1966) who is engaged in modernizing the concept of interest as inventoried by the Strong; and
3. Bordin, Nachman, and Segal (1963) who enunciated a need satisfaction framework for the mediation of vocational memberships in personality development.

Vocational Self Concept and Career in Personality. The further differentiation of theory in vocational choice according to the concept of vocational development finds strong expression in research on vocational self concept. Some of the better delineated lines of research on the harmonization of personality and work through the development of a vocational self concept are those of:

1. Super and associates (1963) in which the meta-dimensions of self concept are being defined and studied;
2. O'Hara and his students (1967) in which the development of self awareness through attention to vocational choice has centrality;
3. Harren (1964) in which pragmatic means for studying the Tiedeman and O'Hara (1963) stages in development of educational choice and accommodation have emerged;
4. Matthews and Friend (in press) in which the specific development of vocational behavior in the personality development of women is at issue; and
5. Lofquist and associates in which specific hypotheses from their general behavioral theory of vocational choice and adjustment (Dawis, England, and Lofquist, 1963) are being tested.

In modern vocational psychology the development of career in personality finds union also with the concept of socialization, with revised educational practice in relation to the "new curricula", with studies of the organization as a specific sociological unit, and, finally, with the total economy as a frame and vehicle of vocational and career behavior.

Vocational Maturation: A New Goal in Occupational Fact Mediation. Clearly, we have moved far beyond the vocational psychology of World War II which was primarily based on the prediction of success and/or satisfaction in educational and vocational opportunities. Vocational choice is now nested into vocational development, vocational development into self concept and personality development, personality development into curriculum development and socialization, and finally organization and economy are emerging as two powerful forces occurring in interaction with individual initiative to forge vocational identity. If you share our conviction that we presently have both an enlarged and a sound basis for theory in vocational development, then we trust that the following two conclusions will have credibility for you, namely:

1. We presently have a new goal for occupational information, that of vocational development, not mere occupational entry and success; and
2. Our enlarged understanding of vocation in personality now gives us social as well as individual means whereby we may "massage" those research facts of vocational development which we have sketched for us in the interest of more fully helping persons turn those facts into occupational information for themselves. When persons do so they move toward vocational maturity. Vocational maturity is a goal we expect that persons will accept on a personal basis.

Personal Responsibility for Goal Determination During the Mediation of Occupational Facts/Data:

Needed Structure of Authority in Turning Development into Maturation

Personal Responsibility and Vocational Maturity. The previous section concluded with statements that vocational development has become an appropriate goal for occupational information and that the theory of vocational development is sufficiently advanced to give us a new concept of what we actually need to mediate, namely, vocational maturity. We know, and our critics keep insistently drawing our attention to the fact, that the society, its economy, and its organizations help persons to harmonize initiative and efficiency during the course of personal evolution in vocational identification and personality development. However, we counselors and other educators still have a staunch interest in cultivating individualization during the course of the socialization of that collaborative activity known as work. Our resolution on this score brings personal responsibility for goal determination into the mediation of occupational facts/data and maturation into fore as goal of vocational development. Personal responsibility for goal determination is a necessary part of personal development through the educational process. Therefore, it must remain a central index of our success in bringing the goal of vocational development into the mediation of occupational information for the purpose of cultivating vocational maturation. Let's now attend to this fact more carefully.

Personal Responsibility and Pedagogy. The strategy for cultivating personal responsibility during education has one of its foundations in the pedagogy of discovery teaching such as Bruner (1962) recommends. In discovery teaching, goals and structures which are originally those of the teacher are offered to students with expectation that the student will incorporate them into his own response repertoires. This pedagogy recognizes that the process of incorporation mediates the responsibility of the student as he takes a structure known to another and make it his own. During this process the student himself discovers the teacher's structure, thereby achieving insight into the subject which the teacher offers him for his understanding.

The pedagogy of discovery teaching tutors the student in seeing a teacher's undertanding of a phenomenon in relation to the teacher's own desire to share that understanding with him. This pedagogy expects that there will be a placing of shared goal determination into the awareness of the student. It also offers the student practice in determining specific, personal goals within a general set, or range, of goals permitted by the structure of the teacher's subject as well as by the personality of the teacher involved in letting another learn by himself within broad limits defined by the teacher.

The pedagogy of discovery teaching opens the door for individual action during learning. However, the application of goal determination to other areas of living involves the assumption of initiative in goal determination in the absence of a pre-determined set of possibilities. This is the process of generalizing a discovery pedagogy upon which counseling focuses. The matter of choice becomes central in personal goal determination.

Guidance in Education and Vocational Maturity. Tiedeman recently applied the above analysis of the functions of guidance in education (Tiedeman, 1966) to an analysis of the general choice conditions inherent in the process of maturing. The results of this analysis led him to emphasize that choice involves the bearing of the predicament of commitment with tentativeness (Tiedeman, 1967). In this analysis of the paradox of choice conditions, he differentiated two central issues. One central issue surrounds the actual assumption of responsibility to relate oneself to future opportunity as if there is an avenue of possibility and responsibility available to one. This issue Tiedeman calls that of choice determination. The second central issue is his analysis of choice conditions deals with the evolution of goal, given the assumption of responsibility to choose. This condition he refers to as that of goal determination.

Tiedeman's recent writing on the understanding and bearing of the choice paradox as a central and critical part of self development represents a culmination of the work he initiated with O'Hara in 1963, work which itself produced the monograph, Career Development: Choice and Adjustment (Tiedeman and O'Hara, 1963). In that monograph, he and O'Hara analyzed career development in relation to a model of decision-making. Since that time, Tiedeman has himself worked with subsequent students, Frank Field (Tiedeman and Field, 1965) and Gordon Dudley (Dudley and Fletcher, 1965) to delineate a way in which he could argue for the articulation of decision-making structures in individual lives without threat to the individual right of goal determination during process of personal decision-making. Tiedeman believes that he now has a logical system which is both possible and appropriate. The system is that of mediation as we develop it here today.

A Structure of Educational Authority Appropriate for Vocational Maturation. The central part of our position is that the cultivation of understanding of decision-making in the paradox of living takes place in an educational context. In the educational context involving the discovery pedagogy the responsibilities for efficiency and initiative can be divided between counselor and teacher.

The teacher has prime responsibility for the goals of accuracy and discovery with particular respect to the subject he is assigned to teach. The teacher is only secondarily interested in the emergence of insight on the part of his student during course of discovery as well as in growth in understanding of self-as-process under expectation for personal responsibility in learning.

The counselor on the other hand has primary responsibility for seeing that the goals of insight and self-as-process emerge in the context of discovering a subject at school and in generalizing this awareness to contexts of choice in vocation and life in which goals can only be determined personally. The counselor in his turn has secondary interest in those goals which are primary for the teacher, namely the goals of accuracy and discovery in relation to subjects. The counselor is interested in sharing only the expectation that the student will both be accurate and have discovered but he cannot deny these functions in educational context however much he personally favors the emergence and exploitation of personal initiative in students.

The application of this model of responsibility assigns to the counselor an interest in seeing that discovery teaching is part of the educational establishment in which he is employed. The model presumes, in addition, that the counselor will have a teaching interest in the paradigm of decision-making as it has application both to choice in vocational and other life goals and to learning about self during the course of experiencing and modifying the consequences of a personally-elected goal. For this reason our expectation is that explicit teaching in decision-making should be a part of the guidance program of an educational institution. Tiedeman intends to make the teaching of decision-making explicit in counseling as you will see from his description of the Information System for Vocational Decisions (Appendix B). This system represents Tiedeman's current effort to act upon the understanding of the model outlined here.

Finally, the appreciation of choice paradox in life evolves over a period of time. In this time, the explicit concepts of decision-making become more practiced, understood, and automatic. The critical tasks of the counselor towards these ends are to analyze the projections about choosing in which his students engage. The two conditions of choosing in which projection must be analyzed are those previously designated, namely choice-election, and goal-determination. In either case the counselor has interest in ministering to projections of either an internal or an external kind. The counselor attempts to mediate to the internal projections of guilt in ways such that his inquirer's attention to his own initiative and his practice of action under guidance of his initiative does not have anxiety and/or psychosomatic effects. The counselor attempts to mediate the external projections of shame so that blame becomes effectively assessed by an inquirer engaged in such projections. The counselor's goal is to bring about greater awareness of evaluations and process possibilities for the inquirer during the course of discussions of such projections.

We presume you note our tri-partite contribution to the theory of personal development through vocational development in this discussion. We believe that the mediation of occupational facts/data in an effort to turn them into occupational information for which an inquirer is personally responsible requires all three enumerated conditions: namely, 1) a structure of educational organization in which there is the expectation of personal discovery and the division of teaching and counseling responsibility in which this can go on without serious threat to the individual initiative and responsibility of the students; 2) an explicit teaching by counselors and/or teachers of decision-making, particularly educational and vocational decision-making, such explicit teaching being offered in compatibility with the discovery teaching in other subjects; and 3) an evaluating and/or monitoring system which is explicitly attune to the development of choice behavior in inquirers.

Prospects for Technology and Commerce in the Mediation of Vocational Development for Vocational Maturity

From Theory to Technology in Mediation. It is one thing to enunciate both a new goal and the structure of authority which will be required to attain that goal without serious threat either to individual liberty or to societal disintegration. These matters have been attended to in the prior two sections. It is still another thing, however, to say how vocational maturity can be cultivated within the required structure of authority. We do believe, however, that we have hit upon a good means to our end. That means will be the Information System for Vocational Decisions as it is described in detail in Appendix B.

Occupational Fact Mediation in the Environment of an Information System for Vocational Decisions. As you will note in Appendix B, the ISVD will be fashioned to mediate choice behavior. Several aspects of that system bear particular emphasis within the context of our immediate considerations here.

One aspect of ISVD in need of special attention is that our word "Information" denotes the placing of facts/data into the context of use. Thus the user or inquirer becomes an explicit part of our denotation of "system." We intend to place a student in potentially repeated interaction with a computer-centered environment programmed, not for prompt reinforcing of stimulus-response contiguity, but for an inquirer's personal inquiry.

A second noteworthy aspect of ISVD is that it will be constructed so as to facilitate an inquirer's learning how to harmonize his personal goals and their consequences in a real world by means of repeated inquiries in specific realms of social activity. Because the ISVD will put the inquirer in direct relation with his evolving history and intentions to the extent that such can be motivated and represented through the numbers, letters, and processing available in computer reckoning, it becomes possible to belie the fears of those who view such automation as a process for making decisions for, rather than with, people.

This brings us to the third and final particularly noteworthy aspect of ISVD. Our primary professional task, both in ISVD and even more generally in guidance, is the construction of a meta-system which permits analysis and response in terms of the majority of the variables of anticipated personal determination. For, in sum, the ISVD will represent a first-time physical simulation of the "outside" which a person must first learn to bring "inside" and then to act toward knowing that it is there but knowing also that he need not be "driven" by it, that he can place it in the service of his own personally-determined career development, in the service of his present and evolving maturity.

A Structure for Mediation of Vocational Maturation in the ISVD. Three specific parts of the ISVD will define its particular contribution to the needed process of mediation. One of the specific mediational parts of the ISVD are the media themselves. The ISVD will attempt to take advantage of all the gains in mediation now available to us because of the media-work outlined in Appendix A. The output media designed into the ISVD will include films, film strips, slides, taped messages, and printed reports provided by means of both cathode ray tube and hard-core printer. Input media will include both the typewriter keyboard and the light pen operating in conjunction with the cathode ray tube.

A second mediational part of the ISVD will be its materials. The materials of ISVD will include the best of findings in vocational development and career linking as outlined in the second section of this paper and in Appendix A. Also included will be materials on opportunities, their characteristics and projected possibilities. Finally, materials will include a newly constructed curriculum designed specifically for the mediation of the developmental tasks of career decision-making and development.

A third mediational part of the ISVD will be the computer modulation of access and response in a time-shared mode. The modulation of the totality of formally construable career development through computer control brings timing and supervision into focus in the mediational process for vocational maturation. Timing will be important in terms of 1) frequency of access, 2) sequence of item presentation and data processing and the monitoring of response to same, and 3) intervals between all three kinds of parts. Supervision has importance in terms of 1) the monitoring built into the inquirer-machine interaction itself, 2) the monitoring of the counselor in his supervision of the inquirer-computer interactional environment, and 3) the monitoring of the vocational educator as he engages persons in the tasks of role assimilation which follow upon the making of a vocational choice, however tentatively that choice is held, and the undertaking of vocational preparation.

The ISVD will be on the frontiers of all three realms of the mediational process designed for vocational maturation. However, as indicated in Appendix C, the ISVD will not be alone in any of its approaches to this condition. University and other non-profit organizations with personnel for technological development in education and profit-making organizations with similar staffs all now have at least one representative case participating in developing the parts of the mediation needed for vocational maturity. There is a considerable mass now existing for creation of occupational fact mediation. In conclusion, let's look at the potential economy of such mediation as we also first swiftly review our argument in its totality.

An Economy for Mediation of Occupational Facts: The Counselor and His Mediation of Vocational Maturation

Summary and Challenge. McLuhan and Fiore use their book, The Medium is the Massage, to convey awareness of a quoted statement attributed to A.N. Whitehead; namely, "The major advances in civilization are processes that all but wreck the societies in which they occur." We elect to summarize and conclude on this profound and somber a note.

We have attempted today to make us all aware that we are on the frontier of a new era in vocational guidance. This new era can combine the recent knowledge in vocational development and media which we have gained in order to mediate vocational maturation by massage of self development with the timing and logical processing available in wedding vocational development materials and media presentation under computer control of a great deal of that mediation. Our realization of this new possibility in our society would constitute a major professional advance on the order of the civilization advances to which Whitehead alludes. Maturation for self awareness in career constitutes a change in our civilization not now accepted in our educational and labor establishments. If we can conceptualize that advance, advocate it, demonstrate it, and sell it we will have massaged ourselves and our society so that we may all but wreck both. However, we remind us in conclusion, that the mediation of this process of incorporation of change is the professional forte of us counselors. Therefore, we remain convinced that we all can both incorporate the change we have outlined into our own repertoires and personality and see that the new technology can mediate vocational maturation for all citizens without disaster in our society. It's worth a try. It's now within the realm of our possibilities.

A New Frontier and Its Needed Economy. Government and profit, as well as technologically grounded non-profit, organizations are now each carefully scrutinizing the technology associated with counseling and guidance (see Appendix C). Under such scrutiny, interest, and potential competition, our guidance technology is likely to experience marked change in the near future, probably within the next five years. Let's not be frightened of this potential for change. Let's get ourselves informed of it. Let's keep watch over its theory and thereby give direction to its evolution. We believe we all can do so if we remain interested in mediation for vocational maturation, not just in media for vocational development.

A prime question in the changes which are on our frontier have to do with the construction of an economy in which industry can profit. We do not mean to frighten you counselors, but we do suggest that we stay loose as this economy is reformed. There will be more than enough compensation for each of us. But what is needed?

Marvin Adelson, System Development Corporation, recently only half jokingly suggested to the Panel on Counseling and Selection, National Manpower Council on which he serves, that the government pay career development money directly to citizens on a regular basis in the future, not to counselors. Such an economy would put us counselors into competition for the governmentally-subsidized money of citizens who could then be accurately conceived as our customers and could thereby gradually but more definitely correct any of our misunderstood theories and practices. This economy would also permit the insertion of computer-assisted support systems for vocational decisions into the technology of which our improved service to users could be founded.

Preposterous? Possibly. However, we are on the brink of a revolution in our field. New solutions are bound to be needed. Let's not fight them; let's mediate them!

APPENDIX A

A Partial Inventory of Developments in Mediation in Which the Media Themselves are the Things

Robert Campbell who is responsible for studies in vocational guidance at The Center for Vocational and Technical Education, The Ohio State University was host to a 1966 invitational conference in which the system mediation of vocational development was the theme. Ann Martin, University of Pittsburgh, was co-instigator of the conference. Tiedeman chaired it (see Campbell, Tiedeman, and Martin, 1966). We invited participants who were known to be at work on the mediation of occupational facts/data.

The projects considered in that first conference have since been augmented by two others at a subsequent meeting of the Invitational Conference. However, the two additional projects still fit into the tri-partite framework in which Tiedeman was able to understand the work in media of those who originally met. Therefore, we use his original framework in reporting the research known to us which is currently underway in the mediation of vocational development. We merely fit the additional work into that original framework.

A. Research in Careers. One group of studies represented at the Invitational Conference consisted of studies a) of vocational choice, success, and satisfaction; and b) of instrumentation involved in the study and potential cultivation of vocational development. Included in this group at the Invitational Conference were:

1. Project TALENT. William Cooley and Paul Lohnes represented Project TALENT in this Conference. The reports now coming from the Project represent our best available pragmatic indications of the factor structure of aptitude and interest measures and of the relation of those factors to career elections and career trees. The Project also offers many working multivariate computational routines which will be needed in any on-line computer mediation of career research and/or development.
2. A Study of Intellectual Growth and Vocational Development. This project of the Educational Testing Service is under direction of Thomas Hilton with the assistance of William Godwin among others. The study will relate Hilton's paradigm of decision in vocational development to intellectual growth. The intention is to explore choice development within cognitive development.
3. Related studies not represented at Conference. Vocational maturation as a goal for the mediation of occupational information arises from the Career Pattern Study under direction of Donald Super, the Studies of Vocational Readiness Planning under direction of Warren Gribbons, and the Study of a Vocational Development index under direction of John Crites. The latter two of these continuing studies are funded by the Office

of Education. The Super studies have been funded by various sources. Some of Super's studies are now being supported by a small grant from the College Entrance Examination Board. Each of these studies provides both theoretical foundation and empiric data for the mediation of vocational maturation with a computer-based interactive environment.

The CEEB has also underwritten some of the work of Robert O'Hara and Esther Matthews. The studies of both of these in-investigators has direct relevance to the foundation for career development which is involved in the mediation of occupational information.

A present large study of channels of access to post-secondary education is being done at the Center for the Study of Higher Education, University of California, Berkeley, under direction of Dale Tillery and with considerable financial support by CEEB. This study, School to College Opportunities for Post-secondary Education (SCOPE), will be a five-year longitudinal investigation of patterns of access to post-secondary education. The research is being conducted in four states and will offer solid foundation for conceiving the transitions from secondary to post-secondary education.

Kenneth Hoyt is also contributing to understanding of this transition from school to post-secondary education through his Vocational Specialty Testing Program. That Program is providing validity patterns in direct relation to many vocational specialties.

B. Occupational Information, Problem-Solving, Media, and Their Effects in Vocational Development. This second group of studies encompasses the largest group of interests among the participants of the Invitational Conference. These studies represent a rudimentary transition from the theory of vocational development to the problem of mediating occupational information so that vocational development can be further cultivated. Since each study is singularly defined by its own specific interests, no one of the studies in this group is now conceived as part of the systematic mediation of vocational maturation.

1. Occupational Information. One sub-set of this group of studies is specifically dedicated to the assembly and presentation of occupational information *per se*. One study in this sub-set is being conducted in New York under direction of Alan Robertson and George Dubato. This study provides a model for collecting occupational information of direct relevance to a local labor market. It is also concerned with judgements about the importance of facts/data so that such information can be presented in a parsimonious and effective manner.

A precursor of the New York State Study is being conducted at San Diego under direction of Glen Pierson. This San Diego study is also involved with the collection and effective presentation of information of direct local impact. The study additionally relates itself to the problem of file maintenance and presentation. The San Diego information is presently on microfilm which can easily be recovered because each microfilm is attached to a coded and pre-punched Hollerith card.

2. Media. A second sub-set of these technological improvements in the mediation of vocational maturation has to do with media themselves. Two of the studies in this sub-set are under direction of Thomas Magoon, University of Maryland. One of Magoon's studies involves the construction and trial of single audio messages conveyed by message-repeater tapes. A second of the Magoon studies involves the expansion of this single-message technology into a multiple-message technology. Magoon now has a 23-track tape mechanism under trial.

A more general study of media is under direction of Ann Martin at University of Pittsburgh. The Martin study involves the construction and trial of occupational information using several media simultaneously. Slides, film-strips, and movies particularly interest Ann Martin at the moment. The Martin materials are being developed within a broad theory concerning the harmonization of work, education, and self and with the needs of non-college youth in specific focus.

Keith Whitmore has been an interested participant in the Invitational Conference. Whitmore, an employee of the Kodak Company, is listening to our Conference conversations in order to guide the resources of the Kodak Company into possible entry into counseling and guidance support systems.

3. Problem-Solving and Vocational Orientation. John Krumboltz is engaged in what is likely to become a widening series of investigations of problem-solving experiences which stimulate career exploration and interest. Krumboltz has already constructed and tried kits which highlight the central problem-solving functions from each of several occupations. This work expands his work in decision-making in which he collaborated with H. B. Gelatt, Murray Tondow, Barbara Varenhorst, and William Yabroff at the Palo Alto Unified School District.

   Magoon is also working to specify an effective problem-solving model for educational-vocational planning. Magoon seeks a written form of presentation which can be used with several subjects at once. He is presently particularly focussed upon the transistion from school to college.

   Although they have not been present in our Conferences, several of us Conferees are extremely interested in the game context for career mediation with which James Coleman and Sarane Boocock are experimenting.

4. Curricula for Career Competences. Several projects in curriculum development are worthy of specific mention. H. B. Gelatt, Murray Tondow, Barbara Varenhorst, and William Yabroff in cooperation with John Krumboltz at Stanford have led the way in the teaching of decision-making. Their applications have been at the junior high and high school levels in the

Palo Alto Unified School District. These applications have also found union with computer assistance in educational planning as we note below.

A related but different line of effort is that in the Philadelphia and Chicago School Systems. Helen Faust in Philadelphia and Blanche Paulson in Chicago are working with persons in vocational education to develop materials for career, not occupational counseling. Martin Katz, Educational Testing Service, consults with the Philadelphia project. Katz has suggested several skill units which are important for the development of career competence.

Finally, the National Vocational Guidance Association last year sponsored a Conference (1966) of career researchers, curriculum specialists, and vocational educators which made effort to deal with the teaching of career competence in the regular and vocational curricula.

C. Systems Under Development for the Mediation of Vocational Maturation. Two central issues in the mediation of occupational facts/data for the goal of vocational maturation are a) the media through which facts/data are modulated and b) the offering to the inquirer of personal responsibility for goal delineation. When these two necessary conditions are present, a third and possibly final necessary condition becomes relevant, namely the timing and supervision of the mediation and the responsibility. The questions of timing and supervision in the modern technology of education brings the role of the computer into central focus. The computer can be an instrument of access and presentation under general direction of the programmer and a counselor and the specific direction of the individual inquirer. There are several system approaches to this timing and supervision for occupational facts/data mediation which are represented in the Invitational Conference. They are:

1. Clear Language Print-out of Demographic and Psychometric Data. Thomas Magoon has a project of this name. His efforts will provide a program for an IBM 360-type system which will provide ordinary data for counselors at consoles remote to the 360 computer but present in the counselor's office.

   William Godwin also told the Conference that a still more advanced machine "language" for test interpretation is available at Educational Testing Service under name of PROTRAN. PROTRAN makes it possible to have a clear language print-out of psychometric data which can be given directly to the inquirer, not the counselor.

2. A Pilot Computer Assisted Vocational Guidance Program. Joseph Impelleteri, The Pennsylvania State University, has an operating on-line, computer-assisted vocational guidance program. At the present time, the Impelleteri system is limited to slide presentation and description of occupations. However, the system can be expanded if, and when, film loops, and possibly even movies, can be transmitted via the cables involved in on-line computer assistance of data management and presentation.

3. Information Processing Procedures and Computer-Based Technology in Vocational Counseling. The System Development Corporation, Santa Monica is a pioneer in devising computer-assisted support systems in education. The Autocounselor, the device of Donald Estavan and John Cogswell, has already demonstrated the high potential of on-line computer assistance in educational planning. H. B. Gelatt, John Loughary, and Murray Tondow assisted in the preparation and test of that system in the Palo Alto Unified School District. At the present time, Cogswell and Estavan are assisted by Barbara Rosenquist in the study of vocational guidance in vocational education. These new vocational guidance studies will lead to the fashioning of additional guidance support activities for counselors. They can also lead, in potential, to the fashioning of counselor-like interviews of students in relation to the planning problems inherent in vocational education.
4. Counseling and Support System. The International Business Machines Corporation and the Science Research Associates are presently involved in designing and testing a counseling and guidance support system for use on the IBM System 1500 which may soon be fairly widely available. (This System 1500 is the one particularly noted in a recent Life magazine article on the work of Patrick Suppes and Richard Atkinson at Stanford University.) The System 1500 is ideally adapted to computer assistance in programmed instruction. The IBM-SRA Counseling

and Guidance Support System will probably have many of the elements of computer-assisted instruction as these elements are adaptable to educational and vocational orientation. Their Support System will probably also encompass the numerical and logical processing of data required for the work of the counselor in educational and vocational orientation. Such processing will be limited by the fact of the medium size of the computational and memory units of the processing functions which can be made directly available to the inquirer himself. In addition, the System 1500 will have program, if not direct transmission compatibility, with the larger IBM System 360. Therefore, these plans of the IBM-SRA have considerable implication for us. The System is being developed by Frank Minor of IBM, and Burton Faldett and John Lombard, SRA. Donald Super and Roger Myers are primary consultants, Tiedeman a secondary consultant.

5. Project PLAN. John Flanagan has recently organized Project PLAN within the American Institutes for Research and with the financial support of the Westinghouse Educational Foundation. This project will prepare units for the facilitation of vocational choice and development. The project will also make use of the Project TALENT computer routines to put William Cooley's theory of a measurement system for guidance service at on-line, computer disposal of the counselor.
6. An Information System for Vocational Decisions. As noted

above, we will soon have a new operating IBM-SRA potential at our command. The IBM-SRA system will also have compatability with a larger and later system which Tiedeman and several colleagues are in the process of designing, assembling, and constructing. The Information System for Vocational Decisions is described in detail in Appendix B.

APPENDIX B

A Computer-Based Information System for Career Decisions[1]

In Prospect for Computer Technology

Professor Ellis invited me to address the matter of prospects for the computer in educational research. I was happy to do so as one of his colleagues[2] in the Harvard-NEEDS-Newton Information System for Vocational Decisions. He and I both hope that our System will materially augment prospect for computer technology in guidance and career development.

The Information System for Vocational Decisions (hereafter ISVD) intends to place an inquirer in potentially repeated interaction with a computer-centered environment programmed for his inquiry, not just for prompt reinforcing of stimulus-response contiguity. The context for the inquiries will be education, occupation, military service, and family living. The inquirer may elect at will among contexts. The System will be constructed so as to expect the inquirer to learn how to harmonize his goals and their consequences by means of repeated inquiries in these four important realms of personal activity.

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[1] Speech delivered by David V. Tiedeman in symposium: "Some Prospects for the Computer in Educational Research," AEDS-AERA session on Educational Research, Detroit, Michigan, 3 May 1967. The central portion of this paper has been previously reported as Project Report No. 2.

[2] Other Principal Investigators of the Information System for Vocational Decisions are Russell Davis, Richard Durstine, Wallace Fletcher, Edward Landy, Robert O'Hara, and Michael Wilson.

I stress at the outset that the primary goal of the ISVD will be inquiry, not reinforcement. Because our System will intend to put the inquirer in direct relation with his evolving history and intentions to the extent that such can be motivated and represented through the numbers, letters, and processing available in computer reckoning, it becomes possible to avoid one of the fears which the public has of using computers in guidance, namely the fear that computers will determine lives by making decisions for, not with, persons. Our System will let any inquirer experience practically the same joy and frustration which you computer devotees daily do, namely the realization that the answer is in you, not the machine. Despite our occasional regret upon such realizations, we know that we still persevere. Therefore, the assumption of the ISVD will be that any person can and will persevere through inquiry. A further assumption of the ISVD is that repeatedly experienced failure to find full solutions to questions can be fashioned into mature capacity to proceed on inadequate bases in adult life as an inquirer is brought to realize the care we used in fashioning a System which can take him down the path of, but never completely into, awareness of the operation of his motivational system.

I trust that you understand from my remarks that I plan assembly of a System different from that now imagined in computer-aided instruction or in educational data processing. The Information System will subsume those conceptions as intermediate in the condition of education for responsible career decisions. However, our primary professional task will be construction of a meta-system which permits analysis and response direction in terms of the majority of the variables of this expected responsibility.

How do we intend to do this? That is what I direct the remainder of my remarks toward.

The Career and Choices in Career Development

The context of vocational decision-making offers excellent opportunity for realization of our intention when the computer is given centrality, but necessary incompleteness, in the interacting system in which career development emerges. I define career as personally-given direction in developing vocational activity. I bind a career with expectation that the exercise of personal intention brings with it accountability for self-directed activity. Therefore, I expect that career development requires emergence of self-initiated activity for which a person permits himself to be held to account. When persons do so, we have opportunity to give power to the process of social control by encouraging the independence of freedom and the interdependence of social consciousness.

The forming of career involves a set of decisions which are made throughout life. These decisions are made in the context of education, vocation, military service, and family. The object, plan, and progress of decisions in each of these areas have their own characteristics which I shall comment upon in the next section. The socially-determined choice contexts in which progress in career takes place are as follows:

A. Education. There are six primary choice contexts in which educational histories are forged. Each of these contexts also has a subsidiary context which I shall also note. The primary contexts with their subsidiary contexts are:

1. Choice of secondary school curriculum. The subsidiary choices relate to the kind and level of curriculum and to the specification of skill area within each kind and level.
2. Choice of post-secondary education. Subsidiary choices in a post-secondary education election include the kind and level of opportunity. As final choice of post-secondary education nears, a specific school and/or college must be differentiated from a more general context. This specific differentiation involves choice as a part of a post-secondary education placement function.
3. Choice of a collegiate major. This choice of college major involves choices of kinds of majors and a differentiation of of potential emphasis in terms of analysis, synthesis, and/or reduction to practice in each of the kinds of areas.
4. Choice of a graduate school. This graduate school choice is similar to the choice of a college so I will not repeat further.
5. Choice of graduate specialization. Specialization in graduate school continues the specification of prior college majors in the several areas of knowledge. However, at this time the emphases on analysis, synthesis, and reduction to practice must become clear cut and must be pursued avidly. At the master's level there is likely to be an emphasis on the technology of

a subject; at the doctor's level an emphasis on professional activity.

6. Choices related to the further refining of occupational location by both job and position emphases within general vocational activity. These job and position choices find interrelation with endeavors organized as continuing education.

B. Vocation. There are three primary choice contexts associated with vocational development itself. Each primary context also has its subsidiary contexts. The primary and subsidiary contexts are:

1. Entry Job. This choice involves a first choice of kind and level of occupation. As entry into work nears, the choice must be sufficiently differentiated so that work is initiated in a specific job. This differentiation involves occupational choice with the placement function.

2. Job progress. Choices bringing about job progress initiate emergence of a career. If a person attempts to conceive his job movement in a personal historical context in which he conceives his own vocational activity as progression, he initiates career considerations into his vocational development.

3. Position and career choices. As a person develops a sense of progress in his occupational activity, he begins to focus upon jobs, not occupations; then upon positions, not jobs; and finally upon career, not work. These kinds of choices become salient around midlife if they become salient at all.

C. Military Service. There are three primary kinds of choices associated with the military service aspect of vocational behavior. These primary contexts are:

1. Kind of service. The person must differentiate between army, navy, marines, coast guard, and air force.
2. Level of service. A prime issue at the beginning of military service is the distinction between enlisted and officer status. Some persons start right off to prepare for officer status. However, in either status, promotion also becomes an issue in its proper time as determined by the regulations of a service.
3. Specialization. Within enlisted ranks in particular, choice of specialization becomes important. In the officer's ranks, specialization is likely to be present but not stressed to that degree in which it is stressed in enlisted ranks.

D. Family. There are two primary contexts for choice in the family area. They are:

1. Marriage. There must be a decision about marriage or not. If marriage is elected, a further decision relates to when in life it should occur and/or re-occur. As noted, the marriage context also involves a choice about continuation in marriage with divorce being the legal means for separation, termination, and potential reinvolvement.
2. Family. Style of life in family is also an area in which choice takes place. This area involves choices of size of family, location of household, culture with regard to extended family living, and amount of balance of time among work, family, and recreation.

The System

General Framework

The Information System for Vocational Decisions is deliberately named despite the fact that our connotations for its words are not presently entirely a matter of common parlance. Our word "Information" is intended to connote the placing of facts/data into the context of use. This use of the word emphasizes our belief that facts/data require the context of use if they are to be conceived as information.

Students and workers are to be permitted to turn educational and occupational facts/data into information through the System. Thus the user becomes an explicit part of our connotation of "System." Our connotation reflects our intention to offer the user complete responsibility in choice of educational and vocational goals. Although it is probably inevitable that the computer will be blamed for "error," we do not intend to let the users of the ISVD enjoy the luxury of that impression without contest.

Data Files

The ISVD will have a data file for each of the previously noted four areas of living: occupation, education, military service, and family. Data in each file are to range from general to specific. In addition, data will attempt both schematically to represent the present and to outline the future for a decade or so, such outlining to be in small time increments. These specifications obligate the System both to deal with local job markets and to incorporate data on local job vacancies which will be helpful in placement suggestions.

The fifth data file in the System will contain inquirer characteristics. This file will be in two parts. One part will deal with characteristics of inquirers in general and will report on relationships of these characteristics with later choices and successes of those inquirers. This file will be used both to suggest alternatives to users who need wider scope for consideration and to subject aspiration to the test of "reality" when the user is in a condition of clarification of a preferred alternative. The other part of the inquirer characteristic data file will be the private educational and occupational history of the user as portrayed in his context of developing justification for his preferences and their pursuit and consequences.

Decision-making: The Paradigm for Choosing

Reflection upon facts/data of the several areas will be encouraged with the expectation that the facts/data will be put to personal use. The personal use to which these facts/data are put will additionally be expected to become guided by a paradigm of vocational decision-making which I have fashioned with Robert O'Hara. The paradigm essentially conceives decision in relation 1) to the passage of time, and 2) to the undertaking of the risk and activity required to achieve what one elects to achieve. This conception permits division of the time interval into a period of anticipation and a period of accommodation. Anticipation occurs before the activities of a discontinuity become required; accommodation occurs after activity is required. Stages of exploration, crystallization, choice, and clarification are distinguished within the period of anticipation. Stages of induction, reformation, and integration become possible within the period of accommodation. Distinctions among these stages will have to be a central part of a MONITOR computer routine in the ISVD.

Computer Routines[1]

Computer routines and supporting materials will be fashioned to conform with expectation that this vocational decision paradigm both exists and can become explicit and useful to someone who practices its use. The paradigm will determine the computer routines which we will develop to permit access to each of the data files and to provide data upon request. There will be three primary computer routines: REVIEW, EXPLORATION, and CLARIFICATION.

The REVIEW computer routine will permit call up and comparison of a prior statement about a then future event both after that expected future event has occurred and after the user has provided indication of how his prior expectations were fulfilled before he sees his prior statement of those expectations. The procedure will expect a person to experience insight with regard to consistency, and inconsistency available during comparison, and to learn from such insight that his own intuition guides his activity. The intended outcome of REVIEW is that the user learn from his history.

The EXPLORATION computer routine will allow the person to rove through a data file as near randomly as possible. The routine will encourage use of randomness largely at only general levels of materials in order to conserve time but will not forbid specific exploration if, and when, desired. Furthermore, routines will be developed to suggest alternatives on the basis of comparison of personal characteristics with established associations between such characteristics of others and their preferred alternatives. The intended outcome from this routine is 1) emergence of a set of alternatives, and 2) the bases on which the alternatives are preferred. I emphasize this latter point in effort to increase your awareness of the reasoning process that is actually involved in career development.

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[1] The basis for this plan is due to Allan B. Ellis.

The CLARIFICATION computer routine will be available after specific alternatives are selected. CLARIFICATION will take the user into queries about the depth of his knowledge concerning the then favored alternatives and the understanding of future alternatives which are likely linked with present preferences. The outcome desired from CLARIFICATION will be the dispelling both of some doubt and of some ignorance concerning the next step in the progress of career which the person is evolving. Lessening of both doubt and ignorance is likely to increase the user's confidence in meeting the required activities of his next step.

In addition to the three primary computer routines, MONITOR will be available as the only secondary computer routine. MONITOR will essentially consist of the evaluations which we are able to concoct to determine existence of mastery of stages in the paradigm of vocational decision-making. For this reason, MONITOR must be able to play back into, as well as over, the computer inputs which the person generates. There will be three essential aspects of MONITOR. The first aspect will be the actual procedure which we concoct and program the computer to provide. The second aspect will be the bases on which we have caused our judgements to operate among the data put in by the person during his interaction with the computer. The third aspect will be the basic computer routines themselves which the person will be taught to use _if and when he desires to have them_. This aspect will make it possible for the user to write his own monitoring bases to some extent and to have these monitoring procedures play among his material just as ours did originally. We hope through MONITOR to encourage mastery of the concept of feedback and to give practice and supervision in its application.

Materials

The computer routines will incorporate the vocational decision-making paradigm. We do not expect that the computer will itself be sufficient to mature fully the capacity and confidence for use of the decision-making paradigm. We will therefore design two other activities into the System in its totality. One of these other activities will be the simulation of decision-making. Simulation will be available in 1) games, 2) booklets in which the concepts are taught, and 3) decision problems of a vocational nature which must be solved in interaction with the computer.

The second of our other activities which we hope will further mature the use of the paradigm of vocational decision-making will be the actual provision of responsibility for work under laboratory and practice conditions. In laboratory and practice, reality can replace imagination if there is intentful supervision of our users as they practice.

This supervision will probably be of the same nature as that employed by counselors with our users as they are engaged in the simulated activities of vocational decision-making during the user-computer interactions.

Career: The Maturation of Personal Responsibility Through Vocational Development

I have so far attempted to show that the Information System for Vocational Decisions will expect choice and will cultivate the capacity for, and confidence in, choosing by giving users almost infinite possibility for the exercise of decision-making among data files while simultaneously attempting to make the processes of decision-making both explicit and mastered. These are elements in vocational development which have previously neither been unified in this manner nor made available for practice in modes in which complexity is possible but time is not of the essence, at least not the time of persons other than the person engaged in the exercise. The existence of the ISVD will therefore be a first-time physical representation of the "outside" which the person must first learn to bring "inside" and then to act toward knowing that it is there but knowing that he need not be "driven" by it if he is the master of it.

In its totality the ISVD will represent "reality" in its data files, offer processes for working with facts/data through its primary computer routines, and provide practice for integration of a differentiated condition. The System will provide practice under supervision through 1) its secondary computer routine, 2) its simulation of decision-making, and 3) its personal supervision a) by a counselor of the person in interaction in the computer routine and b) by a vocational educator as the student user assumes real work responsibility in laboratory and practice work situations.

The System's Status and Prospect in Computer Technology

The ISVD has formally existed only since 1 June 1966. Since that time we have 1) assembled necessary personnel, 2) worked out our location in a complex University, and in collaborations with the Newton, Massachusetts School Department, and the New England Education Data Systems, 3) delineated our need for computational equipment, and 4) started the construction of computer routines and materials. We have also necessarily worked through a plan for our next twelve months, all within the first nine months of our own existence.

The ISVD is supposed to be a working prototype by 1 July 1969. During our thirty-seven month project, we intend to bring the System through two generations of a prototype. The intention is to have practically complete and reasonably accurate specifications of an operating computer system for vocational decisions at the conclusion of the project. We will also have a working second generation prototype, of course.

The signs are good that we can make significant progress in assembling, testing, and further developing our promised prototype. The Radio Corporation of America will figure prominently in our developments. Ellis and I, along with our colleagues, hope that in another two years we may have thereby succeeded in materially increasing the prospects for computer technology in guidance and counseling activities of career development throughout life.

APPENDIX C

Prospects in Mediation:

Commerce in Mediation

As particularly noted in Appendix A, the Office of Education has created a now critical mass of research and development in the mediation of occupational information which causes counselors and vocational educators each to be at a new frontier of their professions. Computer-assistance in the mediation of occupational information may well lose the figurative race between the horse and the steam engine to which John Krumboltz likes to refer. However, we admonish you, as Krumboltz so frequently does, to remember that the race was eventually won by the steam engine. We firmly believe that computer assistance in the mediation of occupational information for vocational maturation will be available and accepted within five years or so. So let's prepare for it. However, let's also be aware of organizations besides the Office of Education which are creating this evolutionary force in the technology of vocational guidance.

Non-profit Organizations. We are only partially aware of research and development centers around the United States which are engaged in the assembly and provision of computer-assisted support systems for vocational decision-making. However, we do know of several organizations of such nature.

The System Development Corporation, Santa Monica, engages in the development of support systems in education. Furthermore, as noted in Appendix A, Cogswell, Estavan, and Rosenquist are presently engaged at that Corporation in enlarging the context of support for vocational guidance.

Actually, the support routines which Cooley and Lohnes have evolved for analyzing the data of Project TALENT also constitute a resource for research in vocational guidance. Some of those support routines will probably be put into the Information System for Vocational Decisions for selective use by inquirers. (It just seems to us that others should be able to learn as much about their careers as Cooley and Lohnes did about theirs as they engaged in the analysis of the career data of Project TALENT.)

The New England Education Data Systems is a membership organization of some 64 school systems in New England. These organizations pay an annual fee on a per pupil basis. The fee entitles members to the services of the NEEDS. These NEEDS service systems presently provide computer assistance for pupil accounting and class scheduling. The development of the ISVD in cooperation with the NEEDS will potentially expand the repertoire of assistance available through that organization. The NEEDS is also simultaneously involved in research intended to expand on-line computer assistance for both instruction and educational administration.

The Educational Testing Service and the College Entrance Examination Board are considering further expansion of operation into the computer mediation of testing and reporting systems. Also, the Measurement Research Center and its subsidiary Systems already have well developed and operating pupil testing, accounting, and reporting routines.

Universities such as California (Santa Barbara), Florida State, Harvard, Maryland, Pennsylvania State, and Stanford are also already developing guidance and counseling support systems.

Profit Organizations. Those of us in guidance seem to be relatively unaware of the entry into our field of profit-making organizations other than those which have made their money on tests and occupational materials. Book, media, and computer companies are looking carefully at developments in counseling and guidance support systems. Let us in our turn, take a look at them.

IBM-SRA is likely to be the first orgainzation to market a counseling and guidance support system. We have mentioned this system in Appendix A. We merely remind us here that a large corporation is interested in our fortunes if we provide a way for them to cultivate that interest for their profit.

Westinghouse has also just entered into an agreement with the American Institutes for Research. This agreement calls for the creation of school relations with AIR which are potentially akin to those we have described for NEEDS. However, at the present time the relationships merely call for free consultation and collaboration in the development and test of the Westinghouse-AIR Project PLAN. The System is presently planned primarily as an on-line, computer-assisted, support system for just the counselor, not for student inquirers. However, there will eventually be computer-assisted units on vocational development which are prepared for student use.

The General Electric and Time and Life amalgam which gave rise to the General Learning Corporation is also a potential resource for construction of computer-assisted systems in support of counseling and guidance. At the present time, GLC's available General Electric time-shared computer is one of the few operating realities of its kind even though its applications are only of a business variety.

The Radio Corporation of America supports research and development in computer assistance in education both at Stanford University and the New England Education Data Systems. This support on the part of RCA will probably permit the ISVD project to secure computer access which is reasonably advantageous to our grantor, the Office of Education.

This list is not exhaustive. Other computing companies are watching developments in this field and will move in with us as our technologies become financially profitable. Companies which provide the hardware and software for media are helping and watching in these developments. Sanders Associates is a good example in the hardware line; Follett Publishing Company which recently incorporated the interests of John Loughary, Harold W. Phend, and Murray Tondow, are good examples in the software line. Large publishing houses which have not had to consolidate with other industries to keep their competitive advantage are also interested and willing to help. McGraw-Hill Book Company and its educational division is a prime example of this kind. Guidance Associates are already well developed in occupational mediation.

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INFORMATION SYSTEM FOR VOCATIONAL DECISIONS

Project Report No. 12

THE ROLE OF DECISION-MAKING IN INFORMATION GENERATION: AN EMERGING NEW POTENTIAL IN GUIDANCE

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The Role of Decision-Making in Information Generation:
An Emerging New Potential in Guidance[1]

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Data Storage and Retrieval: Rudiments of Information

Needed for Guidance: Information Generation, Not Just Fact Retrieval. Walz and Rich recently succinctly described the information process inherent in the Educational Research Information Center (ERIC) program of the United States Office of Education.[2] In this so-called information process, research reports are assembled, abstracted, and indexed. Reference and/or recovery of an article then becomes possible either directly or through index and/or abstract. The direct recovery of an article either bypasses or completes the recovery process. If the recovery process is bypassed, the person inquiring in the ERIC system has either been lucky or he pretty much knew what he wanted when he addressed the system. When article recovery actually completes a process which has included prior reference to abstract and/or index, the person is ordinarily then motivated to read the article because he has already engaged in a prior search for it. In the latter event, however, motivation is a peripheral, not primary, effect of the ERIC program.

The primary reason for ERIC then is to get an article into the hands of interested inquirers, not necessarily to interest the inquirer in inquiry itself which is the purpose of guidance. Therefore, I want to address that peripheral interest developing reason for existence of an information system, namely the capacity to lead an interested but originally uninformed inquirer to articles which are relevant to a reason for the inquiry generated by the inquiry process itself. In bringing your attention upon this distinction, I hope thereby to interest you in the educational capacity latent in data storage and retrieval, not just its recovery capacity. However, before doing so, I want first to remind you of the actual structures of data assembly, abstraction, and indexing themselves as well as of some of the interest generating potential latent in those processes.

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[1] Prepared for CAPS Capsule, Counseling and Personnel Services Information Center, The University of Michigan, February 1968.

[2] Walz, Garry R.; and Rich, Juliet V. "The Impact of Information Systems in Counselor Preparation and Practice," Counselor Education and Supervision, 1967, 6, 275-284.

Abstracting and Indexing. Walz and Rich indicate that two preparatory phases are required to aid identification of relevant articles for an interested but somewhat uninformed inquirer. The first phase is that of abstracting the original article. Abstraction moves the meaning of an article from the realm of detail to that of generality. A good abstract is one which reduces the original while still remaining reasonably consistent with it. Since abstract and original are never identical, there is always a loss of detail in an abstract. However, the abstracter engages in considerable effort to insure that the reduction of meaning because of abstraction is small.

The second phase in making relevant articles useful for an interested but somewhat uninformed inquirer is that of indexing. The first task of indexing is to assign the article to each of one or more primary categories of the several pre-determined categories. Natural language processing of the words of an abstract now permit such indexing to be done by computer. The second task of indexing is the cross-indexing of articles to a secondary set of the pre-determined categories. This secondary task of recognizing and responding to synonyms of primary terms is accomplished by means of a thesaurus. Assignment of articles to synonymous categories is now also accomplished by computer once a thesaurus is placed in the memory of the computer.

After the abstract of an article has been indexed, recovery of the article becomes possible by direct selection of indexed terms. However, direct selection ordinarily leads to a large quantity of citations in a system of the magnitude of ERIC. The number of recovered citations can be reduced and the relevance of the reduced number of citations increased by using what Walz and Rich refer to as "coordinate index terms." "Coordinate index terms" are two or more of the indexed terms and/or their synonyms. When the inquirer uses "coordinate index terms" he succeeds in identifying citations occupying the union of the two or more index terms which he has selected. The use of "coordinate index terms" in an interactive computer system starts with the construction of a sentence which describes the desired citations. The sentence as decomposed and re-sequenced by computer programs then in turn operates the computer and leads to a list of the citations fulfilling the conditions of the union of "coordinate index terms" actually specified by the original sentence. Programming of computers now makes this approximation of sentence-like demands for data possible, practical, and even reasonably satisfying.

Potential for Information Generation Inherent in ERIC. Walz and Rich carry their argument from the above delineation of information retrieval to consideration both of predictable outcomes and of implications for pupil personnel services. These predictions and their implications consitute a potential possible in ERIC but not now thoroughly implanted as I shall then go on to show.

Predictable outcomes of the process of data decomposition and article retrieval are, according to Walz and Rich: 1) synthesis and evaluation become dominant processes; 2) gaps in the information structure become evident; 3) use of impersonal resources increases; 4) opportunity for inter-professional interaction increases; 5) information, not a book, is retrieved; and 6) time to information is reduced and the band width of information is increased. The implications of data decomposition and article retrieval for pupil personnel services are: 1) the approach to learning will become that of inquiry; 2, 3, 4) the information generation process will require new learning approach skills including stress upon the processes of evaluative integration and of information coagulation, not absorption; 5, 6) changed methods of professional communication and increased collaborative efforts will occur; and 7) small esoteric information systems will develop.

Walz and Rich have enumerated important sets of outcomes and implications. However, their conclusion is:

> Perhaps one of the most important conclusions to be drawn from reviewing the outcomes and implications of information systems is that they may well not be a significant force for change. Wherever we have used "will", we just as well could have inserted "can". We are more assured that the mechanics of information systems are workable than we are that individuals can make the necessary changes in attitudes and beliefs to use them. The emergence of information systems is undeniably a force for change in counselor education. Whether it results in changes or not will depend upon the professional response to that force.

Goal: Information Generation. Walz' and Rich's conclusion is an exact one for the ERIC system itself of which they write. However, it is not a necessary conclusion for all computer-controlled interactive systems. Inherent in the ERIC project are only rudimentary conditions of information generation, namely data reduction and interactive retrieval. Missing, however, are the elements of data reduction by the inquirer himself and his subsequent retrieval of reduced data while explicit attention to decision-making is being created during both his reduction and retrieval processes. These missing elements will be a deliberate part of the Information System for Vocational Decisions (ISVD) which several colleagues and I[3] have under construction. The missing elements to be furnished by the ISVD will actually turn data retrieval into information generation, the process I want to highlight for you. However, I must first describe the ISVD itself before I can continue to highlight information generation.

The Information System for Vocational Decisions

Primary Data Files. The Information System for Vocational Decisions is to be a system in which facts/data[4] about educational, military, and vocational opportunities are to be turned into the information of a personally-determined career. The ISVD will therefore consist of three primary data files, one for each of those opportunities. The ISVD data files will be much like the files of abstracts created for the ERIC system. However, each of these three primary data files in the ISVD will itself be partitioned in several ways. One of these partitions in each file will be for its use in exploration or clarification. The facts/data of an educational, military, and occupational alternative will be fewer and at a more general level for the exploratory mode than for the clarificatory mode. When exploring an inquirer will not be expected to maintain preference for an alternative; he will be expected to be forming his bases for preferences among a personally-favored set of alternatives. When clarifying, the inquirer will be expected either to maintain his preference for an alternative or to return to exploration. In this phase of decision-making, the inquirer is expected to bring the perspective of doubt to a previously crystallized basis of choice and to bear the anxiety of ignorance in the face of new facts about the chosen alternative.

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[3] Principal Investigators of ISVD are Russell Davis, Richard Durstine, Allan Ellis, Wallace Fletcher, Edward Landy, Robert O'Hara (Executive Director), David Tiedeman (Chairman), and Michael Wilson. Research Associates of ISVD include: Duncan Circle (1967-68); David Clemens (1966-67); Lawrence Lerer (1966-69); and Eugene Wilson (1966-69).

[4] Facts/data come in two conditions, fixed and modifiable. I therefore elect to adopt the cumbersome term, "facts/data", to indicate this fact throughout the paper. Facts are directly recoverable without mediation except for storage and later recovery. On the other hand, data must be additionally processed by the numeric and/or linguistic routines of a mediational system.

The second partition of each of the primary data files will be applied within each of the exploratory and clarificatory parts of a data file. The second partition will be by the discontinuity in life for which the data file is conceived to be pertinent. In the case of the education data file, steps will be toward subject specialization as represented in the choices of: 1) high school curriculum; 2) post-secondary institutions; 3) post-secondary specialty; 4) graduate institutions; and 5) graduate specialty. In the case of the military data file, steps will be toward promotional opportunity within choice of enlisted and officer ranks of each of the three Armed Services. In the case of the occupation data file, steps will be toward specialization as represented in the choices: 1) occupation; 2) job or placement; 3) position and/or promotion; and 4) career.

The occupation data file will have an adjunctive file which will incorporate forecasts for occupations and permit file blocking of occupational facts/data according to national and regional conditions. The primary purpose of this set of forecasting facts/data will be developed later while discussing the planning phases of career decision-making.

Purpose and Self Development. The ISVD will offer access to the three primary data files within the context of achieving purposeful activity during self development. Two pedagogical modes will be provided for this context. One pedagogical mode will be teaching about concepts relevant to purpose in self development. The concepts included in this mode will be: 1) the psychology of becoming purposeful; 2) self and decision-making; 3) psychological attributes and educational, military, and occupational decisions; and 4) any needed instructions for use of the three primary data files.

The second pedagogical mode will be that of decision-making applied to the data both of another's life and of one's own life. The basic pedagogic mode with the data of another's life will be that of a game. An inquirer and others will either cooperate or compete in playing rounds with the data of another's life and his decisions which are to be anticipated. This game context essentially requires time planning in relation to future possibilities and consequences. The context of time planning will be in terms of education, work, leisure, and family. Future possibilities and consequences will be retrieved from the forecasting data file mentioned earlier. The playing of rounds of the game will provide rudimentary simulation of career development. However, the ISVD will also let inquirers substitute their own data in the game structure and will then use this simulated career development structure in personal decision-making. In personal decision-making, the basic pedagogic mode will be that of guidance in counseling.

Subsidiary Data Files and Routines. The substitution of one's self for the life circumstance of another will create need for two kinds of subsidiary files. One subsidiary file will be that of the individual's education and psychological characteristics. This file will be created and maintained both to permit counselors to call for cumulative records and to permit individual inquirers to generate alternative possibilities for themselves at decision points by using the predictive framework in relation to the anonymous psychological characteristics and choices of previous persons whose histories of prior psychological characteristics and later accomplishments are stored in this file. This particular technique will in the ISVD be augmented by a procedure due to Thomas Hutchinson. The Hutchinson procedure will allow the inquirer to specify both alternatives he is considering and levels of reward which he seeks from each specified alternative. The procedure will then provide indication of whether the inquirer's psychological data are like those of others who before him chose the alternative and achieved the designated rewards or not.

The second subsidiary file will store the elements of the person's decisional frameworks in working out his life plans. The file will consist of summary statements which the person generates at the conclusion of each personal decision-making episode and of the cognitive structuring of his career arising from using the routines of REVIEW, EXPLORATION, and CLARIFICATION applied repetitively in relation to each discontinuity with which the person addresses his future and learns from his past in the ISVD. The inquirer will of course himself be engaged in abstracting his life circumstance while creating these data for his file.

Inherent in the subsidiary file on the person's decisional framework will also be a procedure due to Terence J. O'Mahoney. This procedure will be a paired comparison of vaguely pictured occupational activities presented for reason of exposing the person's self concept in the context of occupational activity. These paired comparison operations applied to pictures will give a person clearer understanding of himself in ideal and actual terms. The understanding will then be an explicit basis upon which the inquirer can deepen his knowledge of his union of personality and occupation. Use of the procedure will be available for the mode of exploration, not clarification. In short, the O'Mahoney procedure will be one of the System's procedures for permitting decision in an educational, military, occupational, and family context for reason of discovering harmonies and disharmonies in personal psychologies and activities. The pictures of the single illustration which O'Mahoney now has available will have to be expanded for such more widespread use, of course.

From Facts/Data to Information:
MONITOR as Information Generating Function

Information from Facts/Data. Walz and Rich indicated in the quotation noted earlier that the existence of data reduction and retrieval can have the consequences of theirs which I enumerated prior to the quotation itself.

However, Walz and Rich stop somewhat short of asserting that data reduction and interactive retrieval acutally will have the noted consequences. I in turn claim that the Information System for Vocational Decisions brings data reduction and interactive retrieval into a condition where the Walz and Rich consequences actually will be realized, not just can be realized. I interrupted my defense of that assertion by the necessity to describe the ISVD itself as an interactive data reduction and retrieval system embedded within decision-making. Decision-making thereby has the role of information generator in the ISVD. Facts/data are turned into information by the inquirer within the context of decision-making when decision-making is subject to MONITOR, a concept I now specify.

ISVD and MONITOR. The basic scheme of ISVD is to have data files in which previously known facts/data are stored. The System will then expect and shape personal interaction with the data files. Personal interaction is both to be taught and to be used in the System. Use of the System can first be as a game and then in the reality of one's own life. Access by way of the routines, REVIEW, EXPLORATION, and CLARIFICATION, provide the context of use in one's own life under guidance of the System. The Access Routines will depend on the primary and coordinate index terms coded into the data files. These index terms will be such as to locate synonyms within and between files and to cross-reference categories from file to file. The thesaurus of synonyms and the coordinate index terms will primarily be developed from vocational development, vocational maturity, and agency development theories.

MONITOR will then be fashioned to operate at three levels. At the rudimentary level vocational development, vocational maturity, and agency development theories will just be used within the paradigm of decision-making which O'Hara and I have specified.[5] The System will itself be programmed to assess the quality of decision-making as applied to the categories of the data files within the several theories. This will provide a first-order and mechanistic way of guarding against failures of personal operation during the decision-making uses of the ISVD.

The second level of operation of MONITOR will be that of giving the inquirer access to the rules and procedures of the first-level monitor. The inquirer will need to be taught how abstracts and the primary and coordinate index terms as well as the thesaurus of the data reduction process inherent in the REVIEW Access Routine are made. The inquirer will also have to be given access to the actual procedures by which a primary and coordinate index and thesaurus operate in the computing system. He will then be permitted to use his own primary and coordinate index terms and thesaurus to process the summary data collected during REVIEW of his career development. This procedure actually creates the smaller esoteric information systems which Walz and Rich predict will spring up within the conception of ERIC. However, within the ISVD these smaller esoteric information systems will be really personal and not accessible to another except upon authorization of an inquirer. In fact, the smaller esoteric information systems actually are the rudiments of the cognitive structure upon which the inquirer premises his personality in the realms of educational, military, vocational, and family

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5. Tiedeman, David V.; and O'Hara, Robert P. Career Development: Choice and Adjustment. New York: College Entrance Examination Board, 1963.

decisions. ISVD will thus encourage the existence and applaud the formation of smaller esoteric information systems. These personal guidance systems constitute the compromises with totality which the individual must make in order to function within the expectations that he will be accurate, detailed, and honest with himself in an ever-maintained effort to perfect his understanding of his actions and his experience.

ISVD and Meaning through Thought, Counseling, and Supervision. Although the substitution of a personal "MONITOR" for the original System MONITOR represents a giant step toward understanding in individuality, it does not represent the completion of the process. Completion of the process further requires the machine-free use of "MONITOR" in the practiced ease of skilled appreciation of thought in experience and action. This condition is never fully attained; it is only ever more closely approximated.

The approximation to effortless ease in skilled appreciation of thought in experience and action, requires generalization of two phases of "MONITOR". One of the phases of "MONITOR" which must be generalized is that of the language of "MONITOR" itself. MONITOR will necessarily be linguistic. As Dudley and I indicate,[6] language can never be fully co-extensive with experience. Therefore, the inquirer must be encouraged to see "MONITOR" as but a stage in understanding the harmonization of language and experience, not the end result itself. The end is more akin to realization of language and experience as a paradox[7], a predicament capable of being understood and appreciated but incapable of full formal construal in co-extensive fashion.

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6. Tiedeman, David V.; and Dudley, Gordon A. Thought, Choice, and Action: Processes of Exploration and Commitment in Career Development; Cambridge, Mass.: ISVD, 220 Alewife Brook Parkway, 1967. (Multilith)
7. Tiedeman, David V. "Predicament, Problem, and Psychology: The Case for Paradox in Life and Counseling Psychology," Journal of Counseling Psychology, 1967, 14, 1-8.

The second parts of "MONITOR" which must be generalized in reaching for a practiced ease with thought, choice, and action is the experiencing of the condition in social, not just machine, context. In short, the person must move his personal "MONITOR" from machine context to interpersonal context. The counselor who supervises the inquirer's discovery of his personal "MONITOR" within the interactive computer processes of the ISVD must be the first agent of generalization of "MONITOR" from machine to interpersonal context. The counselor must use his own interaction with the inquirer as laboratory for that generalization and his skill in assessment of creative processes as his professional activity in that generalization. The supervisor of a person at school, Armed Service, or work must be the second-line agent of generalization of "MONITOR" from machine to interpersonal context. The supervisor must also use his own interaction with the inquirer as laboratory for the generalization but must in turn focus his skill in assessment and cultivation of creative processes on the substance of the inquirer's role obligations in the particular situation under supervision. Finally, the inquirer is himself the ultimate agent for generalization of "MONITOR" from machine to interpersonal context. The inquirer must experience the weakness of the machine MONITOR within the context of his fantasy for control over circumstance and gain confidence thereby in his capacity both to know and not to know his anticipatory guidance system and its consequences in his life space.

But Ultimately Only Another Further Approximation of Information Generation. I trust it is clear that the Information System for Vocational Decisions with its expected ramifications into non-machine and personal collaborative activity offers potential through MONITOR, "MONITOR", counseling, and supervision of turning the processing of facts/data because of data reduction, retrieval, and use into an information generating function which in turn is used, understood, and appreciated. In this sense I believe that what Walz and Rich suspect only can happen within ERIC will happen within ISVD.

Despite the strength of my assertion for the information generation potential of ISVD, let none of us suffer the delusion that information generalization will actually occur universally. The ISVD will expect information generation to happen. The ISVD will consistently attempt to make information generation occur. The ISVD will be diagnostic about failures of information generation to appear. However, the ISVD will only actually accomplish information generation with those inquirers who both catch on to its theory and themselves come to use that theory without defense toward the System's part in its origin. Polanyi[8] is of similar mind with regard to the general theory of tacit understanding within which the ISVD is organized. Because of the general appearance of tacit understanding throughout past generations who lacked ISVD, I am persuaded that the rate of occurrence of this phenomenon will be even greater with use of ISVD than it is without use of the ISVD. If so, Walz' and Rich's predictions and implications will happen, not just can happen. Only the frequency of occurrence of their implications will then remain in doubt.

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[8] Polanyi, Michael. "Logic and Psychology," American Psychologist, 1968, 23, 27-43.

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INFORMATION SYSTEM FOR VOCATIONAL DECISIONS

Project Report No. 14

GETTING A GUIDANCE MACHINE TO UNDERSTAND ENGLISH

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Graduate School of Education
Harvard University

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Getting a Guidance Machine to Understand English

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I

To create an environment for deciding is a central purpose of the Information System for Vocational Decisions project (ISVD). The kind of deciding that we care most about is vocational deciding, and it is quite natural, therefore, that at the base of ISVD is the theory proposed by David Tiedeman and Robert O'Hara (1963) concerning the process of career decision-making. Underlying this theory is the idea that a student's decisions about a career, to be good, must be made in the context of his life span rather than in isolation. When a person takes choice points as they come, making a vocational choice here and another one there, he runs the risk of stringing together decisions that are poorly related and often contradictory. But when decisions are made with a view to future possibilities and with regard to the strengths and weaknesses of past choices, then today's decision has meaning not only in terms of today's problem but reflects as well a sense of continuity. In ISVD we assert that the best way to foster in an individual this sense of continuity, and along with it a sense that he can have considerable effect upon what happens to him in the future, is to create for him a setting for career decision-making.

Some of us call this setting a reckoning environment because we want students to do more than just make up their minds. We want them to figure up, measure, estimate, compare, judge, make calculated guesses, and in the end take responsibility for their decisions. This, of course, is what 'deciding' means, but often people equate decision-making with choice-making and thereby miss the inherent notion of the process and its extension over time. What is left, usually, is the mistaken idea that a person decides by making up his mind, and thus we hear about the *moment* of decision as though it all happens at a point in time which is discrete and unbounded by thought and reflection. To make it clear that it is precisely this misconception and the resulting inflexibility we wish to challenge in ISVD, we have come to refer to the setting for vocational decision-making which we are creating as a vocational reckoning environment.

Along with the student himself there are two additional components within the ISVD reckoning environment. The first of these is an extensive collection of data about the world of work. Facts about jobs, colleges, trade schools, military specialties, and about the student himself are just a few of the types of data to be stored and made available to him. These data are organized into five major data files: occupational, military, educational, personal and family living, and student characteristics. Naturally, while each of these files is separate from the other, they all reference each other so that a student may follow a question through all its aspects.

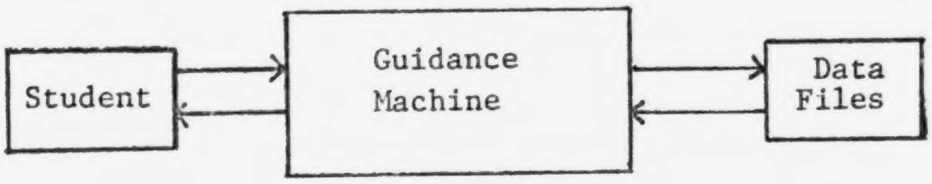
An important point which ISVD wants the student to realize about data is that in the real world they are never complete. Often it is precisely this incompleteness of data about the world of work that makes decisions necessary in the first place. Thus, before one begins the process of decision-making he must understand the incompleteness of the data with which he is dealing.

> "Accepting data on these terms . . . one is more likely to take responsibility for the choices he makes, since they are not totally determined by external factors. If they were, then choice would be either irrelevant or superfluous. Furthermore, in order to create information on which to base decision, one must *actively* process data rather than passively be guided by them, and therefore, the [*student*] must become a significant agent in the choice process. That is, the incompleteness of data implies that the individual is *responsible* for his decisions in both meanings of the word: he is the one who makes the decisions, not someone or something external to him; he is the one who enjoys or suffers the consequences. This is one way to define 'freedom' and it is to this notion that the project is dedicated. It will achieve this goal by developing in the student the ability to engage in this kind of decision-making relative to his career choice. That is, the project will place the student among resources, enhance his access to them, teach him the stages in decision-making, and have him engage the resources in a controlled setting so that he can develop the skills of processing data and making decisions."
> (Ellis and Wetherell, 1966)

The result we hope for is that by developing these skills the student will cultivate in himself a *sense of agency*, that is, the belief that he is the significant agent in determining what happens to him.

Between the student and the data we intend to place a guidance machine. The function of this third and final element of the ISVD reckoning environment is to facilitate students' access to data and vice versa. That is, not only do we wish to provide a means for the student to gain convenient access to data, but we wish to keep track of such access as well. In this way, not only can an individual get facts with which to make decisions, but he can also gain a sense of the way he goes about making decisions.

One way, then, to describe the vocational reckoning environment of ISVD is shown in this diagram.



Now, of course, there is no such thing as a guidance machine, and the major task of ISVD, therefore, is to build one. Instead of building this machine in the usual way with pliers and screwdriver, however, ISVD is transforming a computer into a guidance machine and this paper is a progress report on one aspect of this not inconsiderable task.

It is not an unnatural task, of course, since computers are made for this sort of thing. What most people call a computer program is in fact an explicit statement of a procedure, and at the same time a description of the machine needed to perform that procedure. This is a behavioral description, but it is all that a computer needs in order to imitate the machine so described. It is the purpose of ISVD, therefore, to create a sufficiently explicit description of the behavior of a guidance machine so that a computer can behave as though it were that machine.

Our efforts to create a description of a guidace machine fall into two categories. The first is the development of 'Necessary Evil Software.' This consists of a fairly elaborate set of computer programs which permits certain basic and generally required functions to be performed. We need, for example, to operate in a time-shared setting so that more than one student can use the system at any one time. Furthermore, we must provide the ability to create, maintain, edit, and retrieve data files. A programming language to allow both string manipulation and list processing, programs for statistical analyses, routines to permit content analysis, and the general facility of keeping track of who is on the system and what needs to be done next are some other examples of the kind of Necessary Evil Computer Software with which we must be concerned.

The second category, and perhaps the more interesting one, is the development of ISVD software. These are the programs that enable our time-shared computer to behave like a guidance machine, and it is here that any substantive contributions of ISVD rest.

The single, most significant component of the ISVD software is that network of routines we call *scripts*. Not unlike the manuscript of a play (from which it gets its name) a script is a set of rules describing how the guidance machine is to act. Scripts contain such things as the text to be presented to a student via either a video display device or a printer, commands to activate a tape recorder, or motion picture projector or to display a 35mm slide, instructions for how to process the student's responses, and rules for any computation or storage or retrieval of data.

We believe that a major feature of scripts must be the ability to allow what appears to be conversation between an individual and the guidance machine, because so much of the process of deciding consists of unstructured behavior (such as browsing through data files). Thus, the student must be free enough to generate his own questions in as natural a form as possible. To this end we have spent some time in exploring the problem of getting a computer to seem to understand and to respond to English questions posed by the student. This paper is a report on the progress we have made in our examination of this question.

II

There has been, of course, a number of efforts in recent years to get computers to deal with English sentences. Among these the works of Simmons (1962), Helm (1965), Bobrow (1963), Stone (1966), and Green (1961) are especially relevant to ISVD. While we have been carefully examining the work of all these men to determine how we might benefit from them, this paper will confine itself to one such examination. Specifically, we will describe our effort to adapt to our needs the computer program call ELIZA developed by Joseph Weizenbaum of the Massachusetts Institute of Technology. (1963, 1966, 1967)

While ELIZA is a computer program, it is convenient to think of it more as a scriptwriting language. This language permits an author to specify certain kinds of natural language conversations between man and machine. The ELIZA program accepts as input, scripts which describe the nature of the desired interaction. It is the job of the main program to process these scripts.

An ELIZA script is divided into two parts: a keyword section and a program section. The keyword section contains keywords and decomposition and reassembly rules. "The keywords provide some hint as to what the student is talking about while decomposition rules provide a way to analyze his sentence to determine what he is saying." (Taylor, 1967, p. 10) The reassembly rules describe how the program is to fashion a response to the student's input, while the program part of the script contains further details of what is to be done when there is a match between a decomposition rule and an inputted sentence.

Specifying keywords is particularly important in ELIZA and entails not only constructing a relevant set of such words but also requires a concern for their position in an input sentence. Consider, for example, one possible response to the question

WHAT WOULD YOU LIKE TO DO TODAY?

I want to play the game of baseball with you.

This sentence matches the decomposition rule:

(0 (*play take use see try) 0 game 0)

(Meaning: any number of words, including no words at all, followed by one of the words in parentheses, followed by any number of words, followed by the word 'game', followed by any number of words.)

GAME is an important keyword in this script since it connotes an important part of the ISVD system. In the above example the machine has "recognized" the fact that the student would like to play a game, but it does not know which once since the word baseball was not picked up. The decomposition rule is very general and will probably match many different inputted sentences. Since this is the case, it must transfer control to a general statement which says:

> WITHIN THE ISVD SYSTEM THERE ARE ONLY TWO KINDS OF GAMES THAT YOU CAN PLAY. ONE IS CALLED THE LIFE CAREER GAME AND ONE IS A RISK TAKING GAME. WHICH ONE DO YOU WANT?

Rather tactfully, it reminds the student that in order "to play" the system he must stay within its context. Now consider the following:

I WANT TO PLAY THE LIFE CAREER GAME

The above decomposition rule would match this input as well but the response would be inappropriate. So we must make a more specific rule:

(0 (*play take use see try) 0 life career game 0)

and the transfer is directly to the game.

However, what if the student had said:

I CERTAINLY DO NOT WANT TO PLAY THE LIFE CAREER GAME

This sentence would match the above decomposition rule and transfer directly to the game, which, of course, would be an inappropriate response. So we must provide another decomposition rule that would provide for the negative:

(0 not (*play take use see try) 0 life career game 0)

Obviously then, the only way that we could be absolutely sure that the machine would understand what the inquirer is saying is to specify all the alternative decomposition rules with a particular keyword -- an almost impossible task! How many ways can you use the word 'game' in a sentence? How many and what words could possibly precede and follow it? The best we can do is to create our decomposition rules based on a confidence level of expected student response.

In an ELIZA script, decomposition rules are listed in order of generality, the most specific listed first, and so on. The following is an example of the keyword section in our ORIENTATION script for the word 'game', specifically the rules of play:

```
(game(game(    ---specification of keyword
(0 how 0 (*play take use see try) 0 risk 0 game 0) () aaa
(0 how 0 (*play take use see try) 0 life career game 0) () bb
(0 rules 0 life career game 0) () bb
(0 rules 0 risk game 0) () aaa
(0 rules 0 game) (which game are you interested in.) o
DECOMPOSITION RULE      REASSEMBLY RULE         TRANSFER POINT TO
                                                PROGRAM SECTION
```

Aside from keywords, decomposition and recomposition rules, ELIZA operates on several other powerful mechanisms. The first of these is called a DLIST. This function allows the scriptwriter to tag certain words as belonging to a particular category. Consider the following:

```
(MOTHER DLIST(/FAMILY))
(FATHER DLIST(/FAMILY))
(BROTHER DLIST(/FAMILY))
(SISTER DLIST(/FAMILY))
```

Mother, father, brother, and sister are all tagged family. This saves considerable time in decomposition rules. Instead of specifying a decomposition rule for each word, the scriptwriter can do the following:

```
(0 LOVE 0 (/FAMILY) 0 )
```

which means: match an inputted sentence that has any number of words, followed by the word LOVE, followed by any number of words, followed by any word tagged FAMILY, followed by any number of words.

Now a reassembly rule would allow the computer to come back with an appropriate response:

(0 LOVE 0 (/FAMILY) 0) (WHY DO YOU LOVE YOUR 4.)

The 4 refers to the fourth element in the decomposition rule. In this case, the word tagged family. A conversation could go like this:

S: I LOVE MY MOTHER.

C: WHY DO YOU LOVE YOUR MOTHER.

S: BECAUSE SHE'S NICE TO ME.

C: DO ANY OTHER REASONS COME TO MIND.

(This response is triggered by the word "because".)

Another important mechanism is the ability to make substitutions in the student's input and then apply decomposition rules to the revised input. For instance, some of the substitutions that we made were:

(OF COURSE = YES.)

(YEAH = YES.)

(NATURALLY = YES.)

(RIGHT = YES.)

What happens then is that any time 'of course', 'yeah', 'naturally', or 'right' occur in the input, the computer substitutes the word 'YES'. If we are looking for a YES response from the user and he types in any of the above, his input would then be treated as a YES.

A third mechanism is known as the table mechanism. This is powerful because it keeps track of the context of the conversation. It is used when there is a possibility of several different user responses, each of which refers to a previous context. For instance, a user might answer a question YES, NO, or UNSURE. In the keyword section of the script we have the following:

```
(0 YES 0 DLIST(YYY))
(0 NO 0 DLIST(NNN))
(0 (/UNSURE) 0 DLIST(ZZZ))
```

Each decomposition rule is given a tag; the first is tagged (YYY), the second (NNN), and the third (ZZZ).

In the program section following the question, is the table.

```
*A TYPE ('DO YOU LIKE TO PLAY GAMES.'), NEWTOP('(YYY AA NNN AB ZZZ AC
O'E M), TABLE).
```

The instructions to the computer go as follows:

TYPE the sentence 'DO YOU LIKE TO PLAY GAMES'. If he answers 'yes' go to the label (another piece of text usually) AA; if he answers 'no' go to the label AB; if he answers a word tagged 'unsure' go to the label AC; otherwise (O'E) go to the label M. STOP, wait for input (indicated by the period following the last parenthesis).

Another important feature of ELIZA is the ability of one script to call into play another script, to switch control and to return to the main script when that level of conversation has been terminated. We made heavy use of this ability.

For a more complete description of ELIZA, refer to the work of Taylor (1967), and Hayward (1968).

III

Stated simply, our task was to experiment with ELIZA in order to demonstrate its usefulness to the ISVD. We think that we have accomplished this task in the writing of demonstration scripts for the Access Routines of EXPLORATION and CLARIFICATION and the ISVD ORIENTATION.

An access routine is a set of scripts that allow an inquirer access to various scripts, procedures, and to one or more of the system's several data files. In the ISVD, they are named EXPLORATION, CLARIFICATION, and REVIEW in an effort to use names close to the conditions in the Tiedeman-O'Hara paradigm of decision-making.

Our scripts, therefore, are inherently different from those developed elsewhere in that they serve as calling (access) scripts or as data collection scripts. The purpose of a calling script is to ascertain what the inquirer (i.e. user) wants to do: does he want to access the occupation data base, play the Life Career Game, developed by Sarane Boocock (1967), or think about which colleges to apply to? After the script has determined what it is that the inquirer wants, it calls in the appropriate materials.

A data collection script, on the other hand, asks for specific information from the inquirer (e.g. what factors are important to you in thinking about college choice?), then analyzes the information and stores it for later use in the system.

In the demonstration ELIZA ISVD script system, the ORIENTATION script is used as the main calling script. The keywords in this script refer to our three primary data files (occupations, military, and education), and to the Life Career Game.

An inquirer as he goes through the ISVD ORIENTATION script may or may not know what he wants to do in the system. If the latter is the case, control is transferred to a script designed to help him choose an activity by checking his personal data file for suggestions.

In the following example the computer's output is upper case, and the student's input is in upper and lower case.

WHAT WOULD YOU LIKE TO DO TODAY?

I don't know.

HAVE YOU THOUGHT ABOUT WHAT COURSES YOU ARE GOING TO TAKE NEXT YEAR?

Yes.

WOULD YOU LIKE TO EXPLORE THAT FURTHER NOW?

No.

WELL, HAVE YOU THOUGHT ABOUT WHAT YOU WOULD LIKE TO DO AFTER YOU GRADUATE FROM HIGH SCHOOL?

Yes I want to go to college.

WOULD YOU LIKE TO TALK ABOUT COLLEGE CHOICE?

O.K.

FINE. SINCE WE KNOW THAT YOU HAVE NOT EXPLORED YOUR COLLEGE CHOICE WITH THE SYSTEM BEFORE, THE FIRST THING WE WOULD LIKE TO FIND OUT IS IF YOU HAVE THOUGHT ABOUT THIS CHOICE ENOUGH TO HAVE SOME ALTERNATIVES IN MIND. IF YOU DO, TYPE THE NAMES OF EACH OF THE ALTERNATIVE COLLEGES. IF NOT, TYPE IN THE WORD NO.

After an activity has been selected (in this case, college choice) control is transferred to one of the access routine's scripts.

If we think of the ISVD as a network of scripts, then the student is given a choice of three different kinds of scripts:

1) he can declare himself ignorant of vocationally relevant concepts and thereby gain access to concept teaching scripts;

2) if he realizes that future decision affect his life (plan, style, etc.) and he wants to find out how, he can elect scripts for practice (such as the game);

3) if he wants to play the game for real, using his own data and applying

1 and 2, he can gain access to the decision-making access routines (EXPLORATION, CLARIFICATION, and REVIEW).

In the Tiedeman-O'Hara paradigm of decision-making, the purpose of exploration is to generate alternatives. "Activity is to be planned so that alternatives are selected and so that preferences start to form." (Tiedeman, October 16, 1967). After an inquirer has explored any number of alternatives, crystallization should produce preferred alternatives and the bases on which those alternatives are favored. The purpose of the CLARIFICATION access routine is to test how strongly the individual maintains his commitment. Major activities in the routine are those that determine if the bases for crystallization and choice do in fact exist and that the individual is aware of them, and also those activities that determine if these bases are realistically sound or too inhibitive.

The access routines must allow an inquirer to vacillate between EXPLORATION and CLARIFICATION when an "alternative comes to mind, is only partially pursued, is augmented by another alternative which in turn is only partially pursued, and . . . the repetition of these pursuits somehow gives rise to the formation of a superordinate structure in which you can see crystallization and evoke the belief that one has chosen." (Tiedeman, October 16, 1967)

Since our intention was first to create a demonstration of ELIZA's capabilities we did not complete all the scripts that these access routines require. We feel satisfied, nonetheless, that the capabilities of ELIZA will allow us to come close to reflecting the Tiedeman-O'Hara paradigm of decision-making.

The following extended example of a student's interaction with the ISVD EXPLORATION and CLARIFICATION scripts will serve to indicate the ways in which ELIZA is being applied to our problem. We provide such a lengthy example to suggest not only the capabilities of our demonstration system but also to provide a sense of the kind of flexibility we wish to offer the student.

WHAT WOULD YOU LIKE TO DO TODAY.

I want to think about colleges to apply to next year.

SINCE WE KNOW THAT YOU HAVE NOT EXPLORED YOUR COLLEGE CHOICE WITH THE SYSTEM BEFORE, THE FIRST THING WE WOULD LIKE TO FIND OUT IS IF YOU HAVE THOUGHT ABOUT THIS CHOICE ENOUGH TO HAVE SOME ALTERNATIVES IN MIND. IF YOU DO, TYPE THE NAMES OF EACH OF THE ALTERNATIVE COLLEGES. IF NOT, TYPE IN THE WORD NO.

Harvard University, Boston College, and Berkeley.

GOOD.
WHAT KINDS OF THINGS DID YOU DO IN EXPLORING COLLEGE CHOICE. DID YOU READ ANY COLLEGE CATALOGUES OR TALK WITH YOUR GUIDANCE COUNSLEOR. MAKE AS COMPLETE A STATEMENT AS POSSIBLE.

I read the catalogue for Harvard and Boston College. I talked to my guidance counselor, and had a couple of interviews with the Dean at Harvard. My father went to Berkeley so that's why I'm interested in going there.

THESE ARE THE ACTIVITIES THE MACHINE HAS RECOGNIZED OR ANALYZED FROM YOUR STATEMENT. YOU HAVE DISCUSSED THE MATTER WITH MEMBERS OF THE FAMILY, SPOKEN WITH A GUIDANCE COUNSELOR, READ SOME COLLEGE CATALOGUES, SPOKEN WITH COLLEGE OFFICIALS.
HERE ARE SOME OTHER THINGS THAT MAY BE A GOOD IDEA TO DO IF YOU HAVEN'T ALREADY. YOU COULD HAVE DISCUSSED THE MATTER WITH A TEACHER. NOW THEN, LOOK AT THE LIST OF EXPLORATION ACTIVITIES THAT YOU PERFORMED OUTSIDE OF THE SYSTEM. HERE IS THE LIST OF YOUR PRESENT ALTERNATIVES.
HARVARD UNIVERSITY, BOSTON COLLEGE, AND BERKELEY. NOW TYPE IN THE ACTIVITIES THAT YOU FEEL HELPED YOU MOST IN MAKING UP YOUR MIND OR GAVE YOU SOME ALTERNATIVE COLLEGES TO THINK ABOUT. PLEASE TYPE THEM IN IN ORDER OF IMPORTANCE.

The interviews and talking with my Dad.

GOOD. BEFORE WE GO ON TO EXPLORE COLLEGE CHOICE, WHAT ARE THE FACTORS THAT YOU THINK ARE IMPORTANT IN CONSIDERING WHICH COLLEGES TO APPLY TO.

Grades, Class rank.

ANYTHING ELSE.

Tuition costs, test scores.

HERE ARE SOME OF THE FACTORS THAT OTHER STUDENTS FOUND IMPORTANT
(1) CURRICULUM CHOICE (2) COURSE SELECTION (HIGH SCHOOL SUBJECTS)
(3) GRADES (4) CLASS RANK (5) TEST SCORES (PSAT, SAT, CEEB, ACT)
(6) EXTRA-CURRICULAR ACTIVITIES (7) FUTURE VOCATIONAL PLANS (8) GOAL IN GOING TO COLLEGE (9) POST COLLEGE EDUCATION AND/OR TRAINING.
HERE IS YOUR LIST.
GRADES, CLASS RANK, TUITION COSTS, TEST SCORES. LOOK AT BOTH LISTS AND THEN TYPE IN ALL FACTORS FROM BOTH LISTS THAT YOU CONSIDER IMPORTANT IN THINKING ABOUT COLLEGE CHOICE.

High school courses, grades, class rank, test scores, tuition costs, future vocational plans.

FINE. THERE ARE SEVERAL WAYS THAT YOU CAN GO ABOUT THINKING ABOUT COLLEGE CHOICE WITHIN THE ISVD SYSTEM.
YOU CAN GO THROUGH SOME CONCEPT SCRIPTS WHICH ARE DESIGNED TO GIVE YOU SOME FACTS ON TOPICS RELEVANT TO COLLEGE CHOICE. OR YOU CAN PLAY THE LIFE CAREER GAME. USING THE DATA OF A MAKE BELIEVE STUDENT WHO IS LIKE YOU IN SOME WAYS YOU GO THROUGH THE PROCESS OF SELECTING A COLLEGE FOR HIM.
IF YOU HAVE SPECIFIC COLLEGES IN MIND, YOU CAN GET DATA ON THEM BY ACCESSING THE EDUCATION DATA FILE.
IF YOU LIKE, YOU CAN LET THE SYSTEM GUIDE YOU THROUGH A STATEMENT OF PREFERENCES TO COME UP WITH A LIST OF COLLEGES THAT MOST NEARLY MATCHES YOUR PREFERENCES. OR YOU CAN ELECT TO FIRST GO THROUGH A UNIT ON DECISION-MAKING, A UNIT THAT TRIES TO HELP YOU UNDERSTAND YOURSELF AND OTHERS IN RELATION TO MAKING DECISIONS.
WHAT WOULD YOU LIKE TO DO.

Access the education data file.

YOU HAVE ACCESS THE EDUCATION DATA FILE. FOR DEMONSTRATION PURPOSES ONLY, THE FOLLOWING SCHOOLS HAVE BEEN IMPLEMENTED. HARVARD COLLEGE (MEN), GOUCHER COLLEGE (WOMEN), BERKELEY UNIVERSITY (LARGE STATE SUPPORTED SCHOOL), BOSTON COLLEGE (RELIGIOUSLY AFFILIATED), AND CARNEGIE INSTITUTE (TECHNICAL TRAINING SCHOOL).
THE FOLLOWING FOUR VARIABLES HAVE BEEN IMPLEMENTED. . . COSTS (INCLUDING TUITION, ROOM AND BOARD, AND OTHER FEES), REQUIRED ENTRANCE EXAMS, CRITERIA USED IN SELECTING STUDENTS AND REQUIRED HIGH SCHOOL COURSES.
NOW THEN YOU CAN QUERY THIS MICRO DATA BASE IN ANY WAY THAT YOU WANT.
PLEASE DO NOT USE QUESTION MARKS. IF YOU WISH TO STOP AT ANY TIME, TYPE IN THE WORD STOP.
YOU MAY BEGIN.

How much does it cost to go to Harvard.

TUITION AT HARVARD IS 2000 PER YEAR INCLUDING LAB AND HEALTH FEES. ROOM AND BOARD IS 1170 DOLLARS. NON-RESIDENT STUDENT FEE IS 25 DOLLARS. BOOKS AND SUPPLIES ABOUT 70 PER YEAR. PERSONAL EXPENSES ABOUT 375 DOLLARS INCLUDING ROOM SUPPLIES, CLOTHING, CLEANING AND LAUNDRY, RECREATION, AND OTHER PERSONAL EXPENSES (EXCEPT TRAVEL).

How does that compare with Boston College.

BOSTON COLLEGE'S TUITION IS 1600, ROOM AND BOARD IS 1050 DOLLARS. OTHER COSTS INCLUDE BOOKS AND SUPPLIES ABOUT 100 DOLLARS, LAB FEE 100 DOLLARS AND 30 DOLLARS FOR WOMEN BOARDING STUDENTS FOR HEALTH FEES.

What high school courses should I take for Boston College.

NO SPECIFIC NUMBER OF UNITS IS REQUIRED HOWEVER THE FOLLOWING MINIMUM IS REQUIRED. . ENGLISH(4), ALGEBRA(2), PLANE GEOMETRY(1), FOREIGN LANGUAGE(2), TRIGONOMETRY (FOR STUDENTS PLANNING TO MAJOR IN MATH, BIOLOGY, CHEMISTRY OR PHYSICS (2 FOR STUDENTS PLANNING TO MAJOR IN THE ABOVE SCIENCES AND FOR APPLICANTS TO THE SCHOOL OF NURSING), ACADEMIC ELECTIVES(5).

What specific entrance exams are required.

BOSTON COLLEGE REQUIRES THE SAT AND THREE ACHIEVEMENT TESTS. ENGLISH, LEVEL I OR II MATHEMATICS, AND ONE OF THE CANDIDATE'S CHOICE.

Does Berkeley require the SAT.

APPLICANTS WHO ARE INELIGIBLE, DUE TO GRADE AVERAGE, OR TO UNIT OR DISTRIBUTION DEFICIENCIES, OR WHO HAVE GRADUATED FROM AN UNACCREDITED SECONDARY SCHOOL, MAY QUALIFY FOR ADMISSION BY CEEB EXAMINATIONS. THE THREE ACHIEVEMENT TESTS REQUIRED FOR THOSE APPLYING FOR ADMISSION ARE. . ENGLISH, ONE TEST IN SOCIAL STUDIES OR FOREIGN LANGUAGE, ONE TEST IN MATHEMATICS OR A SCIENCE. REQUIREMENTS FOR CALIFORNIA RESIDENTS. . TOTAL SAT SCORE OF AT LEAST 1000, AND TOTAL SCORE ON THREE ACH OF AT LEAST 1650 WITH NO SINGLE ACH LESS THAN 500.0. REQUIREMENTS FOR OUT-OF-STATE RESIDENTS. . TOTAL SAT SCORE OF AT LEAST 1100 AND TOTAL SCORE ON THREE ACH OF AT LEAST 1725.0.

What are the costs there.

TUITION AT BERKELEY IS 980 DOLLARS PER YEAR OF THREE QUARTERS FOR OUT-OF-STATE STUDENTS. NO TUITION FOR CALIFORNIA RESIDENTS. ROOM AND BOARD VARIES BETWEEN 600 AND 940 DOLLARS. INCIDENTAL FEE OF 242 DOLLARS. ASSOCIATED STUDENTS MEMBERSHIP FEE 11 DOLLARS. BOOKS AND SUPPLIES ABOUT 80 TO 110 DOLLARS.

How do they choose their students.

BERKELEY SELECTS ITS CANDIDATES ON THE BASIS OF A CANDIDATE'S SECONDARY SCHOOL RECORD AND CEEB SCORES. ALUMNI RELATIONSHIP AND GEOGRAPHICAL DISTRIBUTION NOT RELEVANT.

How about Harvard.

HARVARD CHOOSES ITS CANDIDATES ON THE FOLLOWING CRITERIA. SECONDARY SCHOOL RECORD, SCHOOL'S RECOMMENDATION, AND CEEB SCORES. ALSO, CHARACTER, PERSONALITY AND EXTRACURRICULAR PARTICIPATION ARE STRONGLY EMPHASIZED. SPECIAL TALENTS AND INTERESTS ALSO CONSIDERED.

How much does it cost to go to Goucher.

THERE IS A COMPREHENSIVE FEE OF 2950 DOLLARS PER YEAR INCLUDING TUITION, ROOM AND BOARD, AND LAB FEES. STUDENT ACTIVITY FEE OF 13 DOLLARS, HEALTH FEE 50 DOLLARS, AND GYMNASIUM OUTFIT 27 DOLLARS. OTHER COSTS INCLUDE BOOKS AND SUPPLIES ABOUT 100 DOLLARS.

What kinds of courses should I take.

16 UNITS REQUIRED, THE FOLLOWING RECOMMENDED. . . ENGLISH (4), MATHEMATICS (3), (2 IN ALGEBRA, 1 IN GEOMETRY), ONE FOREIGN LANGUAGE (3), HISTORY (2), LABORATORY SCIENCE (1). THE COMMITTEE ON ADMISSIONS MAY ALLOW ENTRANCE CREDIT FOR WORK IN ELECTIVE SUBJECTS NOT LISTED.

How do they pick their students.

GOUCHER COLLEGE BASES IT CANDIDATE SELECTION ON THE SECONDARY SCHOOL RECORD, THE SCHOOL'S RECOMMENDATION, AND TEST SCORES. OTHER IMPORTANT FACTORS ARE PERSONAL CHARACTERISTICS, EXTRACURRICULAR PARTICIPATION, AND INDIVIDUAL INTERESTS. ALUMNAE RELATIONSHIPS AND GEOGRAPHICAL DISTRIBUTION CONSIDERED.

I think that I would like to stop now.

WOULD YOU LIKE A SUMMARY OF YOUR EXPLORATION OF THE EDUCATION DATA FILE.

Yes.

FINE.
YOU GOT DATA ON THE FOLLOWING VARIABLES FOR HARVARD COLLEGE. . COSTS, INCLUDING TUITION AND ROOM AND BOARD, HOW THE SCHOOL SELECTS ITS STUDENTS.
FOR BOSTON COLLEGE YOU GOT DATA ON THE FOLLOWING VARIABLES. . COSTS, INCLUDING TUITION AND ROOM AND BOARD, WHAT HIGH SCHOOL COURSES ARE RECOMMENDED OR REQUIRED FOR ENTRANCE, WHAT ADMISSIONS TESTS YOU SHOULD TAKE.
YOU HAVE FOUND OUT ABOUT
WHAT ADMISSIONS TESTS YOU SHOULD TAKE, COSTS, INCLUDING TUITION AND ROOM AND BOARD, HOW THE SCHOOL SELECTS ITS STUDENTS, FOR THE UNIVERSITY OF CALIFORNIA AT BERKELEY.
FOR GOUCHER COLLEGE YOU EXPLORED THE DATA ON THE FOLLOWING VARIABLES. . COSTS, INCLUDING TUITION AND ROOM AND BOARD, WHAT HIGH SCHOOL COURSES ARE RECOMMENDED OR REQUIRED FOR ENTRANCE, HOW THE SCHOOL SELECTS ITS STUDENTS.
YOU DIDN'T EXPLORE THE AVAILABLE DATA ON CARNEGIE INSTITUTE.
NOW THEN. WOULD YOU LIKE TO GO BACK AND FIND OUT ANYTHING MORE ABOUT THESE SCHOOLS.

No.

WOULD YOU LIKE TO GO INTO CLARIFICATION NOW.

Yes.

OF THE FOLLOWING COLLEGES THAT YOU HAVE EXPLORED, WHICH WOULD YOU CONSIDER APPLYING TO.
HARVARD UNIVERSITY, UNIVERSITY OF CALIFORNIA AT BERKELEY, BOSTON COLLEGE, GOUCHER COLLEGE.

Boston College, maybe Berkeley, and Harvard.

ARE THEY LISTED IN ORDER OF PREFERENCE THAT IS, IS YOUR FIRST CHOICE FIRST ETC.

No.

PLEASE TYPE THEM IN ORDER OF PREFERENCE.

Harvard University, Boston College, Berkeley.

YOU HAVE DECIDED TO GO INTO CLARIFICATION CONCERNING YOUR PREFERRED ALTERNATIVE HARVARD UNIVERSITY.
YOU HAVE ACCESSED THE EDUCATION DATA BASE AND GOTTEN SOME OF THE AVAILABLE DATA ON HARVARD UNIVERSITY.
IN EXPLORATION, YOU STATED THAT YOU CONSIDERED THE FOLLOWING TO BE IMPORTANT FACTORS IN CONSIDERING COLLEGE CHOICE. . GRADES, CLASS RANK, TEST SCORES, COURSES, GOAL.
NOW THEN, YOU SHOULD HAVE A FAIRLY GOOD IDEA OF WHERE YOU STAND IN RELATION TO THESE FACTORS AS WELL AS WHERE STUDENTS ADMITTED TO HARVARD UNIVERSITY STAND. RIGHT.

No.

WOULD YOU LIKE TO GO BACK TO EXPLORATION TO FIND OUT HOW YOU COMPARE WITH HARVARD STUDENTS.

No.

WOULD YOU LIKE TO CHOOSE ANOTHER ACTIVITY.

Sure.

WHAT WOULD YOU LIKE TO DO.

Find out about jobs.

HOW WOULD YOU LIKE TO DO THIS.

I would like to access the occupation data base.

O.K.

THIS OCCUPATION INFORMATION SCRIPT IS AN EXAMPLE OF HOW SPECIFIC INFORMATION CAN BE EXTRACTED FROM THE CIVILIAN OCCUPATION DATA BASE. FOR THIS SCRIPT, THE FOLLOWING FIVE JOBS WERE SELECTED - DOCTOR, LAWYER, BARBER, MACHINIST, AND MUSICIAN. SEVEN CATEGORIES OF INFORMATION ARE PROVIDED FOR EACH TITLE - A DESCRIPTION OF JOB DUTIES, SALARY, BENEFICAL HIGH SCHOOL COURSES, EDUCATIONAL REQUIREMENTS, WORKING HOURS, FUTURE DEMAND, AND PERCENTAGE OF MEN AND WOMEN IN FIELD. IF AT ANY TIME YOU WISH TO STOP, TYPE THE WORD STOP.
YOU MAY NOW BEGIN.

Tell me about the work of a doctor.

DOCTORS ARE PROFESSIONALS WHO WORK IN MEDICAL SERVICES, GOVERNMENT, AND COLLEGES AND UNIVERSITIES. THEIR WORK IS SCIENTIFIC AND TECHNICAL, AND INVOLVES THEM WITH PEOPLE. ON THE JOB THEY DIAGNOSE, AND PRESCRIBE MEDICATION FOR DISEASES, TREAT INJURIES, AND DO SURGERY.

What is his salary.

A BEGINNING DOCTOR CAN EXPECT TO MAKE AT LEAST $6500 PER YEAR, AND MAY EVENTUALLY MAKE A MAXIMUM OF $70000 PER YEAR. SINCE MANY DOCTORS ARE SELF-EMPLOYED, HE CAN SOMETIMES SET THE NUMBER OF HOURS HE WISHES TO WORK AND THEREFORE VARY HIS INCOME.

How many men are there in this profession.

70 TO 95% OF ALL DOCTORS ARE MEN.

What are his working hours.

DOCTORS OFTEN WORK NIGHTS AND WEEKENDS. DOCTORS SOMETIMES WORK OUTDOORS.

Describe his education.

A DOCTOR MUST COMPLETE PROFESSIONAL OR GRADUATE SCHOOL BEFORE ENTERING HIS OCCUPATION. HE NEEDS 4 TO 10 YEARS OF SPECIFIC TRAINING FOR HIS JOB AND THEN 6 MONTHS TO 1 YEAR OF ON-THE-JOB TRAINING BEFORE BEING CONSIDERED A FULL-FLEDGED DOCTOR.

How long do doctors live on the average.

UNFORTUNATELY THERE IS NOTHING FOR THAT SUBJECT.
WOULD YOU LIKE TO KNOW THE TOPICS OF INFORMATION THAT ARE AVAILABLE FOR DOCTORS.

Yes.

FOR A DOCTOR THERE IS INFORMATION ABOUT WHAT HE DOES ON HIS JOB, HIS EDUCATION, ADVANCEMENT, APPLICABLE HIGH SCHOOL COURSES, SALARY, NECESSARY ABILITIES, PHYSICAL DEMANDS OF THE JOB, FUTURE GROWTH OF THE PROFESSION, PERCENTAGE WHO ARE MEN, HOURS, LICENSING REQUIREMENTS, AND WORKING CONDITIONS. WOULD YOU LIKE TO SEE ONE OF THESE TOPICS.

Yes.

WHAT IS IT.

What will be the need for doctors.

CURRENT INFORMATION INDICATES THAT IN THE FUTURE THERE WILL BE AN INCREASING DEMAND FOR DOCTORS.

What high school courses would it be helpful to take to become a doctor.

A HIGH SCHOOL STUDENT INTERESTED IN BECOMING A DOCTOR SHOULD CONSIDER TAKING THE FOLLOWING COURSES - BIOLOGY, LATIN, CHEMISTRY, FOREIGN LANGUAGES, PHYSICS, AND SOCIAL STUDIES.

For a lawyer.

A HIGH SCHOOL STUDENT INTERESTED IN BECOMING A LAWYER SHOULD CONSIDER TAKING THE FOLLOWING COURSES - BUSINESS, LATIN, ENGLISH, HISTORY, SPEECH, AND SOCIAL STUDIES.

What about his pay.

A BEGINNING LAWYER SHOULD EXPECT TO MAKE AT LEAST $5500 PER YEAR. IN ADDITION HE MAY RECEIVE HEALTH AND LIFE INSURANCE AND PAID VACATIONS. SINCE A LAWYER MAY BE SELF-EMPLOYED, HE CAN SOMETIMES SET THE NUMBER OF HOURS HE WISHES TO WORK AND THEREFORE VARY HIS INCOME.

What about a barber.

A BEGINNING BARBER SHOULD EXPECT TO MAKE AT LEAST $65 PER WEEK, AND MAY EVENTUALLY MAKE A MAXIMUM OF $200 PER WEEK. IN ADDITION HE MAY RECEIVE TIPS AND HEALTH AND LIFE INSURANCE AND PAID VACATIONS. SINCE A BARBER MAY BE SELF-EMPLOYED, HE CAN SOMETIMES SET THE NUMBER OF HOURS HE WISHES TO WORK AND THEREFORE VARY HIS INCOME.

And a machinist.

HE MAY RECEIVE FREE ADVANCED TRAINING, OVERTIME PAY, AND HEALTH AND LIFE INSURANCE AND PAID VACATIONS. SINCE A MACHINIST MAY BE SELF-EMPLOYED, HE CAN SOMETIMES SET THE NUMBER OF HOURS HE WISHES TO WORK AND THEREFORE VARY HIS INCOME.

Describe his work.

MACHINISTS ARE MACHINE WORKERS IN THE MANUFACTURING OF METAL PRODUCTS, THE MANUFACTURING OF ELECTRICAL MACHINERY, UTILITY COMPANIES AND THE MANUFACTURING OF MACHINERY. THEIR WORK REQUIRES THEM TO DEAL WITH MACHINES AND TECHNIQUES. ON THE JOB THEY SET UP AND OPERATE MACHINE TOOLS TO MAKE OR REPAIR METAL PARTS OR PRODUCTS.

Tell me about the musician.

MUSICIANS ARE PROFESSIONALS WHO WORK IN SPECIAL SCHOOLS, DANCE HALLS AND SCHOOLS AND THEATERS, ORCHESTRAS, AND CLUBS. THEIR WORK IS ABSTRACT AND CREATIVE AND REQUIRES THEM TO DEAL WITH PEOPLE AND IDEAS RATHER THAN WITH THINGS AND OBJECTS. ON THE JOB THEY ENTERTAIN THE PUBLIC BY PLAYING IN SYMPHONY ORCHESTRAS, DANCE BANDS, OR JAZZ COMBOS.

What kind of an education does he need.

A MUSICIAN MUST COMPLETE JUNIOR HIGH SCHOOL AND SHOULD ALSO GRADUATE FROM COLLEGE BEFORE ENTERING HIS OCCUPATION. HE NEEDS 4 TO 10 YEARS OF SPECIFIC TRAINING FOR HIS JOB BEFORE BEING CONSIDERED A FULL-FLEDGED MUSICIAN.

Stop.

WOULD YOU LIKE A SUMMARY OF YOUR EXPLORATION OF THE OCCUPATION DATA BASE.

No.

DO YOU WANT TO GO INTO CLARIFICATION.

No.

WHAT WOULD YOU LIKE TO DO.

I would like to access the military data file.

IN THE ISVD MILITARY DATA FILE YOU MAY SEE SPECIFIC INFORMATION FOR THE ARMY, NAVY, AIR FORCE AND GENERAL INFORMATION FOR OFFICERS AND ENLISTED MEN.
YOU MAY USE THE MILITARY SELECTION SCRIPT AND LET THE COMPUTER SORT OUT JOBS WHICH MAY BE OF INTEREST TO YOU, OR YOU MAY REQUEST DESCRIPTIONS FOR SPECIFIC MILITARY JOBS.
WHAT DO YOU WISH TO DO.

Take the job selection script.

THE NAVY, ARMY, AND AIR FORCE EACH HAVE HUNDREDS OF SPECIALIZED JOBS. IN ORDER TO SIMPLIFY CLASSIFICATION, THESE HAVE BEEN CATEGORIZED BY FUNCTION ACCORDING TO CAREER FIELDS. THE INFORMATION PRESENTED HERE FOR EACH CAREER FIELD COVERS THE VARIOUS SPECIALIZED POSITIONS INCLUDED WITHIN IT. ALTHOUGH NOT ALL OF THE GENERAL INFORMATION GIVEN WILL APPLY FOR EACH SPECIALTY, YOU WILL RECEIVE AN OVERVIEW OF THE CAREER FIELD. TO DETERMINE WHICH CAREER FIELDS ARE BEST SUITED TO YOU, IT WILL HELP FOR YOU TO ANSWER THE FOLLOWING QUESTIONS. ARMED FORCES JOBS ARE PERFORMED IN MANY LOCATIONS. INDICATE WHERE YOU WOULD PREFER TO WORK BY SELECTING ONE OR MORE OF THE CHOICES FROM THE FOLLOWING LIST.

1. ON LAND
2. AT SEA
3. IN THE AIR
4. INDOORS
5. OUTDOORS

(Note -- For this demonstration, only the first question of the military job selection script is shown. After the inquirer has finished with this segment of activities, he will be queried as to whether he wishes to continue with the Military Data Base.)

ARE YOU INTERESTED IN SEEING OTHER THINGS IN THE MILITARY DATA FILE.

Yes.

AND WHAT WOULD YOU LIKE TO DO NEXT.

What is there to do.

YOU MAY LOOK AT JOB DESCRIPTIONS OR REQUEST SPECIFIC INFORMATION FOR THE ARMY, NAVY, AIR FORCE, OFFICERS AND ENLISTED MEN.

Let me see information about the Army.

WHAT DO YOU WISH TO EXPLORE IN THE ARMY DATA FILE.

What about pay.

HERE IS THE PAY SCALE FOR ENLISTED MEN. ENLISTEES QUALIFY FOR PAY GRADES E-1 THROUGH E-9.

MINIMUM TIME IN GRADE FOR ADVANCEMENT	GRADE	MINIMUM MONTHLY PAY	MAXIMUM MONTHLY PAY
E-1 TO E-2 4 MONTHS	E-1	$ 90.60	$ 129.00 A MONTH AFTER 2 YRS. TOTAL SERVICE
E-2 TO E-3 6 MONTHS	E-2	100.50	141.00 A MONTH AFTER 2 YRS. TOTAL SERVICE
E-3 TO E-4 6 MONTHS	E-3	121.80	193.80 A MONTH AFTER 4 YRS. TOTAL SERVICE
E-4 TO E-5 1 YEAR	E-4	168.60	252.60 A MONTH AFTER 6 YRS. TOTAL SERVICE
E-5 TO E-6 2 YEARS	E-5	200.40	328.80 A MONTH AFTER 14 YRS. TOTAL SERVICE
E-6 TO E-7 3 YEARS	E-6	232.20	387.60 A MONTH AFTER 18 YRS. TOTAL SERVICE
E-7 TO E-8 3 YEARS	E-7	269.40	528.60 A MONTH AFTER 30 YRS. TOTAL SERVICE
E-8 TO E-9 2 YEARS	E-8	428.40	587.10 A MONTH AFTER 26 YRS. TOTAL SERVICE
	E-9	510.60	657.30 A MONTH AFTER 26 YRS. TOTAL SERVICE

HERE IS THE PAY SCALE FOR COMMISSIONED OFFICERS.

RANK: AIR FORCE AND ARMY	NAVY	MONTHLY PAY: NORMAL MINIMUM	MONTHLY PAY: NORMAL MAXIMUM
SECOND LIEUTENANT	ENSIGN	$ 303.90	$ 336.30
FIRST LIEUTENANT	LIEUTENANT JR. GRADE	420.30	504.60
CAPTAIN	LIEUTENANT	583.20	633.30
MAJOR	LT. COMMANDER	700.50	807.30
LT. COLONEL	COMMANDER	930.60	992.40
COLONEL	CAPTAIN	1121.40	1216.50
BRIGADIER GENERAL	REAR ADMIRAL (LOWER HALF)	1295.10	1384.80
MAJOR GENERAL	REAR ADMIRAL (UPPER HALF)	1530.60	1592.40
LT. GENERAL	VICE ADMIRAL	1648.20	1766.10
GENERAL	ADMIRAL	1883.70	2002.60

IS THERE ANOTHER SUBJECT IN THE ARMY DATA FILE THAT YOU WOULD LIKE TO SEE.

What topics are left.

THERE ARE 9 GENERAL CATEGORIES OF INFORMATION IN THE ARMY DATA FILE - PAY AND BENEFITS, EDUCATION AND TRAINING, SPECIAL UNITS, WOMEN IN THE ARMY, PROMOTION, ENLISTMENT REQUIREMENTS, THE RESERVE PROGRAM, AND OFFICER STATUS FOR ENLISTED MEN. IF YOU ARE INTERESTED IN FINDING OUT WHAT ARMY OR MILITARY JOBS MAY BE SUITABLE FOR YOU REQUEST THE JOB SELECTION SCRIPT. WHAT TOPIC OR SUBJECT WOULD YOU LIKE TO INVESTIGATE.

What about officers.

AN ARMY MAN CAN ACHIEVE COMMISSIONED OFFICER STATUS BY ENROLLING AT A CIVILIAN COLLEGE OR UNIVERSITY FOR A BACHELOR'S DEGREE OR BY APPOINTMENT TO THE U.S. MILITARY ACADEMY OR OFFICER CANDIDATE SCHOOL. UPON COMPLETION OF ANY OF THESE PROGRAMS, HE IS COMMISSIONED AS A RESERVE SECOND LIEUTENANT.
WHAT ELSE INTERESTS YOU.

I don't want to continue.

ARE YOU INTERESTED IN SEEING OTHER THINGS IN THE MILITARY DATA FILE.

No.

HERE ARE ACTIVITIES THAT MAY BE OF INTEREST TO YOU. YOU CAN LEARN ABOUT YOURSELF BY STUDYING HOW YOU MAKE DECISIONS. YOU CAN PLAY GAMES WHICH GIVE YOU PRACTICE IN PLANNING EDUCATIONAL AND VOCATIONAL ACTIVITIES. YOU MAY ALSO WORK WITH THE EDUCATION AND OCCUPATION DATA FILES. DO YOU WISH TO LOOK AT DECISION MAKING SCRIPTS, PLAY A GAME, OR WORK WITH THE EDUCATION OR OCCUPATION DATA FILES.

Play a game.

IN THE ISVD THERE ARE TWO KINDS OF GAMES YOU CAN PLAY. ONE GIVES YOU PRACTICE IN TAKING RISKS. THE OTHER GIVES YOU PRACTICE IN PLANNING EDUCATIONAL AND VOCATIONAL ACTIVITIES. WHICH KIND OF GAME WOULD YOU LIKE TO PLAY.

The second kind.

THE LIFE CAREER GAME IS DESIGNED TO GIVE YOU PRACTICE IN FORMING YOUR EDUCATIONAL AND VOCATIONAL PLANS. SINCE YOU HAVE NEVER PLAYED THE GAME WITH THE SYSTEM BEFORE, IT MIGHT BE WISE TO GO THROUGH A GENERAL ORIENTATION. DO YOU WANT TO DO THIS.

Why not.

THINK HARD NOW. WHAT WAS THE FIRST GAME YOU EVER PLAYED.

Tag.

DO YOU REMEMBER HOW MUCH YOU LIKED IT.

Yeah.

WHY DID YOU ENJOY PLAYING TAG.

It was a blast.

AS CHILDREN WE LIKE TO PLAY GAMES SUCH AS TAG, MARBLES, HOP-SCOTCH, TIC-TAC-TOE, AND HIDE N GO SEEK BECAUSE THEY ARE FUN. THESE GAMES ALLOW US TO COMPETE WITH OTHER KIDS TO TRY AND WIN. BUT WE CAN'T SAY THAT THEY REALLY TEACH US ANYTHING THAT IS DIRECTLY APPLICABLE TO EVENTS IN REAL LIFE. SOME GAMES IN ADDITION TO BEING FUN, TEACH US SOMETHING ABOUT REAL LIFE ACTIVITIES. HAVE YOU EVER PLAYED A GAME THAT SEEMED TO BE TEACHING YOU SOMETHING ABOUT WHAT GOES ON IN REAL LIFE.

Of course.

WELL, GAMES LIKE MONOPOLY, BIG BUSINESS, AND RISK DO TEACH US ABOUT THINGS IN REAL LIFE (LIKE BUYING AND SELLING REAL ESTATE, ETC.). WE CALL SUCH GAMES SIMULATIONS.
THE LIFE CAREER GAME IS SUCH A SIMULATION. WHAT YOU CAN LEARN FROM THIS GAME IS THE KIND OF PLANNING THAT INVOLVES MAKING DECISIONS ABOUT THINGS THAT ARE HAPPENING NOW AT THE SAME TIME YOU ARE THINKING AHEAD TO WHAT YOU MIGHT WANT IN THE FUTURE. WHAT KINDS OF DECISIONS ARE YOU THINKING ABOUT NOW THAT WILL HAVE AN EFFECT ON YOUR FUTURE.

I do not wish to continue.

ARE YOU INTERESTED IN DOING SOMETHING ELSE.

No, I would like to stop.

YOU HAVE JUST EXITED FROM THE SYSTEM. GOODBY.

Because this demonstration was created in order to explore certain technical problems, and since this exploration was conducted by members of the Computer Division of ISVD rather than by the professional guidance specialists in the project, we do not wish to suggest that the content or the wording of the scripts are appropriate. Of course, we have come close to reflecting the interaction desired by David Tiedeman and Robert O'Hara, the project directors, but for our present purposes no effort was made to be particularly realistic about such things as reading levels, scope, relevance, or even accuracy of content. Furthermore, we consider our work thus far with ELIZA to be enlightening but rudimentary. We make no claim that the example provided here is anything but a first step toward the kind of natural language capability we seek. There is, for example, no present capability in ELIZA for extensive content analysis of student responses. Nor do we presently have a convenient procedure for combining features of ELIZA with other aspects of our system such as our author language or our statistical routines. Working on this combination is, of course, one of our major intentions.

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INFORMATION SYSTEM FOR VOCATIONAL DECISIONS

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DATAFILES FOR COMPUTERIZED VOCATIONAL GUIDANCE: REQUIREMENTS, PREPARATION, USE

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Introduction and Overview

The Information System for Vocational Decisions (ISVD) project has since its beginning embodied the concept of large, orderly collections of factual information as an important part of its resources. This has led to the acquisition of several such collections of information (datafiles). It has also led to some general understandings about collection, storage, processing, and use of information for computerized guidance. These have now been developed and tested to the extent that a unified discussion of them is possible.

I shall present and explain in this paper the approach to computer-managed information that has thus been arrived at, treating theory and related action, both past and planned.

Throughout I seek consistency with related theory and activities of the ISVD. Innocence of guidance and of computer technology may cause some errors in these areas, though I hope not to the extent of invalidating my major points. These latter are summarized below.

1. Data should be collected and presented specifically to aid students in their vocational decisions.
2. Data should be treated in a form that exploits high speed computation. It hence needs to be systematic and highly structured.

3. The power and flexibility of operation thus gained is worth the price of rigidity of structure.
4. For the present, accuracy is of importance secondary to that of operational design.
5. Ready-made sources of information should be relied upon as far as possible. Direct collection of information is costly.
6. It is important (and possible) to articulate data from distinct and diverse sources into a working whole.
7. A primitive form of mediation between "facts/data" and "information" should be included with the datafiles.
8. Datafiles and means of access to them should be prepared separate from one another so they can be used in a variety of combinations.
9. The information given by the system should be suggestive, not prescriptive. It is the inquirer's responsibility to know and make use of this fact.

Some more specific criteria and general rules for their implementation will be found in the final section of this paper. The intervening discussion supports and elaborates on these general statements, drawing support mainly from the experience of preparing datafiles of occupational and military information for the ISVD.

The Fundamental Task in Preparation of Datafiles

The intended role of factual information in the ISVD implies two special requirements:

1. It should be collected, analyzed, and presented specifically to aid a student ("inquirer") in his vocational decisions.
2. It should be treated in a form that exploits the resources of high speed computation. It needs hence to be systematic and highly structured.

Each of these points is perhaps more significant than it looks.

Much factual information of possible value in personal decisions, particularly occupational decisions, is not generally found in useful form. It tends to be better suited for economists, planners, and employers. It needs special interpretation for profitable use by individuals. The "psychology of occupations" as it has developed is a step in this direction. Also needed is modification of highly detailed information to a form that serves the individual. This is the direction of the work described here.

Second, the need to deal with very large quantities of information, concurrently in many combinations and for many purposes, imposes strict requirements on treatment of that information. Also, a working vocational information system should accept with minimum disruption changes or additions to the information it treats, or to its use. Both these needs lead to involvement of the computer and demand a highly structured system. This degree of structure is the price of size and flexibility. I conjecture that the benefit is often worth that price. It is certainly a possibility worth exploring.

The structure thus imposed on factual information within the ISVD has led to the objection that the result may be "too mechanical." But this is functional and necessary to the approach we are taking. To cover it up would be troublesome and misleading. To eliminate it would for a long time to come be inefficient and costly. To be openly mechanical in this is a simple matter of honesty. A computerized information system that pretends to be fully human has no more self-evident merit than an airplane with flapping wings or a telephone with moveable lips at the earpiece.

It should be noted for clarity that here "information" generally refers to the "facts/data" of Tiedeman. In its ultimate use it may approximate Tiedeman's concept of "information," but since this distinction is not central to the present discussion, it will not be used, except where Tiedeman's work is specifically referred to. "Information" will thus usually be used here in an unspecific and pedestrian sense, more or less interchangeably with "data."

A Datafile and How it Grew

The development of datafiles within the ISVD began with preparation and use of the project's first datafile in the academic year 1966-67. A brief description of this file will motivate some of the conclusions that have been subsequently reached concerning datafiles in general.

The first datafile will be referred to here as the "850 Titles File." It contains information under fifty-six categories about some 850 occupational titles. The categories are shown in Appendix 1. This title-category structure is a useful--and obvious--one for datafiles in general. To render this concept explicit, an illustrative "mini-datafile" is shown in Figure 1.

TITLE	D.O.T. NUMBER	CODED DATA	DESCRIPTIVE INFORMATION
FOREST ENGINEER	005.187	45 0 5 1	DESIGNS AND OVERSEES CONSTRUCTION OF FACILITIES FOR LOGGING
EGG BREAKER	521.887	4 I 2 9	SEPARATES EGGS FOR USE IN FOOD PRODUCTS

Figure 1

Illustrative Short Datafile Based on Occupational Titles

This tiny illustrative file gives a brief verbal description of the activities of workers in each of two occupations. In addition, in coded form, are given:

1. Dictionary of Occupational Titles (D.O.T.) number of the occupation;
2. Working conditions (first two columns under "Coded Data");
3. Education required (third column under "Coded Data");
4. Seasonality of work (fourth column under "Coded Data").

For example, the code "45" indicates that a forest engineer must use his hands, and be able to speak and hear to do his work. An egg breaker, on the other hand, also works with his hands, but need not speak or hear. This information is contained in the position and identity of the letters and numbers in the file. Hence great care is required in designing the datafile to transmit precisely the intended meaning.

The illustrative datafile also tells that a forest engineer works out of doors (an "O" in an assigned position of the file carries this information), while an egg breaker works indoors (indicated by an "I" in like position). Likewise a "5" and a "2," appropriately placed, indicate the levels of general education required for each (some college for the forest engineer, and some high school for the egg breaker). Finally, in the last column of code, a "1" indicates some seasonality in the engineer's work. "9" shows no information on this for the egg breaker.

This trivial illustrative file exhibits all the characteristics and uses associated with any datafile of this form. Though the 850 Titles File requires sixteen punched cards for the coded and other information about each title, it and the illustrative file are identical in their essential characteristics.

The mechanics of construction of a datafile in this form are simple but strict. The way in which each piece of information is to be expressed must be unambigously fixed. Words, numbers, or code may be used. In each case, exact meaning must be decided upon and stated. Words have the most flexibility, of course, and codes the least. Codes are the most economical of space. Since the structure of the datafile is highly rigid, changes or deletions can be made readily. Likewise, additions of titles or of categories are conceptually simple and mechanically straightforward. This flexibility of modification is one advantage bought with rigidity of form. This is of great value for any datafile that can be expected to change in time.

Another point, perhaps less obvious and surely more controversial, is that accuracy of information is of secondary importance for the time being. It is not unimportant, but less so than structure and the means to use it. For this reason, though a diligent attempt was made at accuracy in preparation of the 850 Titles File, no great effort is presently given to its modification and updating. This is a mechanical task, of less immediate interest than learning to use the file in an imaginative and flexible way.

Preparation of a large datafile of factual information reveals the dependence of such files on large blocks of information prepared for other purposes. The work of agencies such as the Bureau of Employment Security and the Bureau of Labor Statistics is invaluable because many of their results can be taken readily and inexpensively into the file. This suggests three further criteria of datafile preparation.

1. Direct preparation of information in large quantities is costly, so that ready-made information sources should be relied upon as far as possible. Some information will eventually have to be gathered and prepared explicitly for the working ISVD, but this must be selected with great care in terms of its cost and its usefulness.
2. Since ready-made information will seldom exactly suit the purposes it is to serve (unless they are the purposes for which it was explicitly prepared), it must be modified to a form as appropriate to the new use as possible.
3. The need to use as many information sources as possible makes necessary the ability to articulate diverse sources or collections of information into a working whole.

The above three requirements arise directly from the need to make maximum use of available resources. This need might be classed by some as regrettable. It is, however, so universal and unavoidable that it is merely one more fact in preparing information for use by the ISVD.

The problem, then, is to handle information in a way that will best serve the uses of the system, given existing technological and economic limitations. In the following pages some steps toward a working solution will be presented.

Clearly the comments here are not limited to information about occupations, though they are derived therefrom and are hence particularly suited to that application. Any data that can be readily described in terms of titles and categories can be treated in this way. Thus these comments have considerable generality. The extent of their applicability must be judged in each individual case of course.

Further issues of collection and storage of information will be discussed later. First, however, it will be helpful to review some theoretical characteristics of the ISVD as they relate to the preparation of datafiles.

Role of Datafiles in the ISVD

In a recent paper ("The Role of Decision-Making in Information Generation," ISVD Project Report 12), Tiedeman has given "primary data files" a central role in his operational definition of the ISVD working system. These primary data files are the datafiles referred to in the present paper, of which the file of occupational titles described above is an example. The centrality of these datafiles within the ISVD thus requires their careful articulation with the system as a whole. The considerations that thus arise are of five kinds.

First, the datafiles (primary data files, in Tiedeman's terminology) will function in the system together with some form of mediation to help convert the "facts/data" of the files to "information" by individual inquirers in the system. A major task of the system is to provide such mediation. Although the preparation of datafiles thus does not require the preparation of such mediating elements, the process of mediation will be helped if the datafiles are properly designed, and if some primitive form of mediation is provided with them. This both justifies and motivates the first steps that were taken toward use of the datafiles described above. These were:

1. Presentation of the contained information in English language form;
2. Provision for selection of information in terms of certain of its more important characteristics.

These two steps toward conversion of "facts/data" to "information" will be elaborated later.

Second, the process of decision-making by the individual inquirer is conceived in the design of the system as taking place at a number of discrete "discontinuities." A central principle of the ISVD is that the inquirer should be helped to maximize his awareness of and participation in these discontinuities. The datafiles in use at any time will be identified in part by the discontinuity the inquirer is dealing with. As the system becomes adept at dealing with a variety of discontinuities, the structure and use of the datafiles to serve this end must be more and more highly refined. Thus the datafiles must remain flexible to varying demands depending on which discontinuity is being served. This is further reason why the highly structured form chosen for the occupational datafile is appropriate to economical satisfaction of the demands of the system. It permits a single datafile to serve a variety of discontinuities.

Parenthetical note: While it is necessary to speak briefly here of the theory underlying the ISVD, this is not meant to be a full or definitive statement of that theory. Other documents should be referred to for that purpose. The intent here is to suggest that the decisions made with regard to datafiles have been appropriate to the overall needs and aims of the system.

Third, the theory behind the ISVD prescribes that the inquirer be encouraged and taught to deal with his discontinuities in terms of a paradigm of several sequential stages. Again the datafiles will be called upon to perform differently depending on which of these stages the inquirer is in. Since at any moment each inquirer is likely to be dealing with a different discontinuity and to be at a different stage of the paradigm, great flexibility is demanded of the datafiles. The structure of datafiles thus far provided is a step in meeting these needs.

Fourth, the capacity of the inquirer to absorb and use information should have some influence on which information is provided to him, and how. The same information might be presented in a number of ways, depending on the needs and capabilities of the inquirer. If the datafile itself and the means of getting at it are separate (i.e., if more than one means of access and presentation can be adjoined to a single datafile) flexibility in use of a single datafile will be increased.

Fifth and finally, several means for mediation of "facts/data" to "information" will be used by the system. These include direct teaching of concepts, simulation, and real experience with decision-making. The datafiles should stand ready to serve these various pedagogical modes. This reinforces the requirements of flexibility, and of access to the files separate and distinct from the files themselves.

A Young Datafile's First Steps

It is clear, then, that the concept of the ISVD and of the operation of datafiles within it are both highly ambitious. Considerable time will be needed to bring them to fruition. It is hardly possible to conceive of there ever being a final system, but rather of a working and evolving system. It is important to distinguish dreams from forseeable accomplishments, and both from present achievements. The latter are important in that they help to confirm and give hope to the dreams. They also point the way to activities needed to bring forseeable accomplishments to reality. It is thus desirable to consider applications of the 850 Titles File as it has developed, not as a final working thing, but as a first step, and as a suggestion of best directions for future development.

It will be recalled that the 850 Titles File consists of some 850 titles with information in fifty-six categories (prepared for computer use by placing the data for each title on sixteen punched cards; transferred subsequently to magnetic tape). It will also be recalled that this information is almost entirely in compact coded form of little direct use to an inquirer of the ISVD.

An obvious question in converting this datafile to use by inquirers is how to present its contents in a form suitable for human comprehension. The answer chosen is fairly simple. The mechanical problem of presentation of coded information is that of converting it to English or some other readable form. A second problem is that of choosing and interpreting information in a way that is maximally meaningful and minimally misleading. The mechanical problem is simpler, and will be discussed first and more fully.

The form adopted for presentation of information from the 850 Titles File can be readily described in terms of the mini-datafile presented earlier. For each of two occupational titles, this file contains a brief description of the occupation plus certain coded information. For the moment it is not important whether this information is either appropriate or accurate. The mini-datafile can answer questions such as "What does an egg breaker do"? "How much education does a forest engineer need"? "Where does an egg breaker work"? Answering such questions requires three steps:

1. Identify which category(ies) of stored information contains the answer to the stated question.
2. Find the appropriate information by title and category.
3. Present answer in terms understandable to the inquirer.

The first two of the above steps are technical ones, to be taken through accurate identification and location of the stored information. The last can be made by constructing a suitable sentence. An example will suffice. To answer "Where does an egg breaker work"?, the system must first identify where information of this type is kept, if it is kept at all. In the illustrative mini-datafile, this is the third column of code, in which an "I" or an "O" is found. From this it is possible to respond "An egg breaker works indoors."

More generally, it can be said: "A (Title) works (x.)" This answers the question "Where does a (Title) work"? The system will place "indoors" in the sentence if the datafile contains an "I" in the appropriate location, and with "outdoors" if there is an "O." If there are further possible situations, such as "both," such a code must be defined, and words provided to interpret that code in the sentence. A special case is the possibility of a blank, or of an illegal answer, in which case some sort of null response would be called for.

The above procedure can be applied with considerable generality, given three things:

1. A skeleton sentence (e.g., "A (Title) works (x).") which makes sense for each possible insertion of (Title) and (x).
2. An English interpretation of the content of the datafile for each possible content. This specifies "x" in the above sentence.
3. A substitute message if the coded information is unavailable or inappropriate.

Satisfaction of the above requirements calls for some precision and care, but is by no means impossible or even particularly difficult. Once the rules are set, new titles can be added--or information added, deleted, or changed in the file. Likewise, the form of presentation can be altered without changing the coded information. Thus to a great extent the content and use of the datafile can be separated, with resultant valuable flexibility.

It is now a direct step to answering the request "Tell me about the occupation egg breaker" or "Tell me about the occupation forest engineer." In either case the answer would be built of the various sentences that answer individual questions about the named occupation. The result will of course seem somewhat mechanical, but with care in preparation it should not be unbearably so. Descriptions for the 850 Titles File have been prepared in this form.

The second question, that of choice and interpretation of information, must be resolved over a longer term, and is much more difficult to handle adequately and honestly. The approach taken so far has been to use whatever data is available, and to be forthright about what it does and does not say. The flexibility designed into the datafile and into the presentation of its contents will then facilitate exploitation of improvements in quality of information as they become available.

The structure of the 850 Titles File, its contents, and the presentation of its information in the form described above, have been described in detail in working documents of the ISVD project. Further elaboration of these topics will not be given in this review article. The question of access to the information in this file will similarly be treated in a brief manner.

Questions about any individual job readily come to mind, and can be listed more or less briefly, particularly given knowledge of the limited scope of information on each title. The choice of occupation(s) to ask about is far less obvious. To simply present a list of 850 titles and say "You may ask about any of these," would be folly. Such a list in its entirety is of little use. Some method of selective access is needed.

The most direct way of making this choice is in terms of selected characteristics of the titles in the datafile. Again I resort to the mini-datafile for illustration. The inquirer might ask "Which occupations involve indoor work and require less than a high school education"? The answer would be, "egg breaker." Let us examine this procedure and its limitations.

1. Response to the question can only be in terms of the occupational titles on the list, which is a limitation of the occupational titles approach. One way of relaxing this limitation will be dealt with presently.
2. Second is the matter of which questions the inquirer can ask the datafile. At the present stage of use of the 850 Titles File, questioning is in terms of responses to a set of multiple choice questions. In a fully free situation, he might make other requests, to which the datafile could not respond. In that case a "don't know" or "unfortunately an answer on this subject is not available" message would have to be prepared.
3. A third eventuality is exhaustion of the file. With the mini-datafile, there are, for example, no outdoor jobs that require less than a high school diploma. With a suitable message, this ceases to be a problem.

Search of the file by the computer for suitable titles is a straightforward matter, subject to the limitations mentioned above, and will see realization in the first working prototype of the ISVD.

It is important to note throughout that the attitude in presentation of data by the system is not prescriptive, but suggestive. The inquirer is not told that he must pursue life as an egg breaker, or even that this is desirable. He is merely informed of this alternative, and that it meets his apparent occupational specifications. A description of the occupation, prepared by the system as described above, tells him other facts about egg breakers (or forest engineers, or whatever), and gives him references to further information. He is then free to try out other sets of specifications, or to accept or reject further consideration of any title, either before or after he has received a description of it.

It is important for the inquirer to realize that the system tells what it is asked, and that it can tell no more than it knows. It is his responsibility to understand and make use of this fact. If handled properly, a system with incomplete information can be of use to the inquirer. This understanding is imperative, because full information will never be impossible. A large and growing body of information will be a reality, however, and can be made responsive to the inquirer's needs, if he knows how to deal with it properly.

Extension to Other Datafiles

Design for an evolving structure of datafiles within the ISVD can be based on experience with the 850 Titles File. First, however, a final dimension must be added to the problem, namely the possibility of a complex datafile composed of two or more files of the type already described.

This extension will be introduced by an example from the actual development of datafiles for the ISVD. The initial collection of information was made in terms of the 850 Titles File. Information from a variety of sources was coded into a highly structured framework as already described. At subsequent times other information also became available, including:

1. The supplementary volume of the Dictionary of Occupational Titles (D.O.T.);
2. Classification by Anne Roe's categories and levels of some 800 occupational titles;

3. Forecasts of demand to 1975 by occupation and industry of some 160 occupational groups and some 120 industrial groups.

The availability of this new information posed an important problem in information handling. In each new case the titles covered were substantially different from one another and from those in the originally prepared 850 Titles File. In the case of the supplement to the D.O.T., virtually all jobs of the earlier datafile were included, so the additional information could be adjoined readily to the 850 Titles File. Waste arises from the fact that this leaves more than 90 percent of the new information unused.

The information about Roe categories and levels (item 2 above) covers about the same number of titles as the original datafile. The two lists are far from being equivalent, however. The bulk of the new information can be put to use by including it where appropriate, and leaving Roe category unspecified elsewhere.

In the case of the forecast information (item 3 above), the situation is considerably different. This information is given not by occupational title, but by occupational group. The titles used for groups of occupations and of industries exhaust all possibilities, referring sometimes to titles as "not elsewhere classified." Whereas there exist occupations that are not found in the D.O.T., there are in principal none that do not fall into one of this smaller set of occupational groups. The two classification systems are thus qualitatively different, and must clearly be treated separately.

Information by occupational title and information by occupational group can be articulated by treating one as an example of the other. Thus an example within the group "structural metal workers" is "pneumatic riveter," which is a specific title in the 850 Titles File. Likewise "pneumatic riveter" can be identified as a member of the group "structural metal workers," and through that identification other example titles can be found. Thus the disparity between the two lists is turned to good use. It adds flexibility to the search for titles of interest.

The above experience can be summarized in general terms as follows.

1. A datafile might very well consist of two or more pieces (title-category blocks) that have distinctly different titles and categories of information included in them.
2. Translation between these can be facilitated by suggesting the titles of each block that correspond to each title of the other. These translations need not be unique in either direction.
3. Free use and flexibility of the datafiles can and should be encouraged by making these translations suggestive rather than prescriptive.

A second case of articulation of the sort described above has been carried out between the occupational datafile and the military datafile. The latter lists categories of assignments for enlisted men. This articulation promises to be helpful to the use of both these files.

Specifications for the Continuing Development of Datafiles

Datafiles for the ISVD and procedures for their use will undergo continuing development. There is no forseeable end to additions or alterations to this material and its uses. Any closed system of datafiles is to be shunned. A general plan for development is needed in which the datafiles are continuously operative, but in which new information can be accepted readily and with minimum disruption of operation. Such a plan is suggested by the experience of datafile development described above. It derives explicitly from the datafiles on occupations and military service, but should apply readily to those on education, family living, and other topics an information system like the ISVD might eventually encompass. Needed are an ability to arrange the information in terms of titles and categories, as mentioned earlier; and to translate among the various sets of titles. The files thus can be readily articulated among themselves. They potentially, therefore, are not a set of datafiles, but one large complex file.

Experience so far with datafile development suggests certain criteria and a set of rules to meet these criteria. These may seem self evident or trivial in retrospect. But they were by no means obvious during the development of the datafiles described here. They might also seem excessively general in form, but this is intentional, to allow application to a wide range of cases.

1. Datafiles should adapt to different use depending on which discontinuity and stage of decision-making they are serving for each individual inquirer.
2. Means of entry to each datafile should be independent from the file itself, so that either the means of entry or the file itself can be changed without disturbing the other.

3. Likewise, form of presentation of information from a datafile should be independent from the file itself for the same reasons.
4. Files should be designed so that additions and updating are possible without undue disruption of the existing files or of their operation.

These criteria, recognized as important in development of the existing datafiles on occupations and military service, must be interpreted individually for each datafile. The following rules have been helpful in this regard.

1. Collect information by blocks in which information in well defined categories is given for a set of well defined titles.
2. Entry to these blocks can be according to selected categories, or by title.
3. Coded information should be presented to the inquirer in English or some other readily understandable form. This in general will require structured formats within which to present the information.
4. Free access between separate blocks of information should be facilitated through explicit translation from the titles of one to the titles of the other. Properly done, this will provide flexibility and freedom in finding and taking information from the datafiles.

Much work remains in the preparation of datafiles. The job will probably never be over, since updating and additions can be expected to go on so long as there is a system. Three immediate needs, which set the stage for the near future, follow.

1. More accurate information, when and as this becomes available in readily usable form.
2. More appropriate information, aimed at individual decision-making rather than economic or large scale planning.
3. Less structured entry to the information. This is mainly a matter of information processing capability and is beyond the scope of this paper.

Appendix 1

Categories of Information from The 850 Titles File and from the D.O.T. Supplement

Category	In 850 Titles File	In D.O.T. Supplement
1. Occupational title	yes	yes
2. Alternate titles	up to five	
3. Entry occupations	up to four	
4. Higher occupations	up to four	
5. Industries where found	up to four	one only
6. Brief verbal description	yes	
7. Worker trait sector (from D.O.T.)	yes	yes
8. Aptitudes: General intelligence	five levels	five levels
9. Aptitudes: Verbal ability	five levels	five levels
10. Aptitudes: Numerical ability	five levels	five levels
11. Aptitudes: Spatial perception	five levels	five levels
12. Aptitudes: Form perception	five levels	five levels
13. Aptitudes: Clerical perception	five levels	five levels
14. Aptitudes: Motor coordination	five levels	five levels
15. Aptitudes: Finger dexterity	five levels	five levels
16. Aptitudes: Manual dexterity	five levels	five levels
17. Aptitudes: Eye-Hand-Foot coordination	five levels	five levels
18. Aptitudes: Color discrimination	five levels	five levels
19. Interest Preferences	up to three	
20. Occupational situations	up to three	up to five
21. Strength required	five levels	five levels

Appendix 1 (continued)

Category	In 850 Titles File	In D.O.T. Supplement
22. Physical demands	up to five	up to five
23. Required high school courses	36 possibilities	
24. Salaries and wages	three levels	
25. Required academic ability	four levels	
26. Required mechanical ability	four levels	
27. Required social intelligence	four levels	
28. Required clerical ability	four levels	
29. Required musical ability	four levels	
30. Required artistic ability	four levels	
31. Required physical ability	four levels	
32. Most common prior activity	up to two	
33. On-the-job training	eight levels	See item 63
34. Formal education required	eight levels	See item 62
35. Formal education preferred	eight levels	See item 62
36. Recommended School courses	up to four	
37. Short training courses	up to two	
38. Distribution of sexes	five levels	
39. Minimum age	yes	
40. License requirement	yes	
41. Union membership	yes	
42. Working conditions	up to six	up to six
43. Place of work (indoor, outdoor)	yes	yes
44. Weekend work	three levels	

Appendix 1 (continued)

Category	In 850 Titles File	In D.O.T. Supplement
45. Hours of work	three levels	
46. Requirements for travel	three levels	
47. Seasonality	yes	
48. Basis of income	four levels	
49. Incentives and fringe benefits	up to four	
50. Opportunities for promotion	four levels	
51. Paths for promotion	up to two	
52. Opportunities for mobility	four levels	
53. Possibility of self-employment	yes	
54. Growth rate of occupation	four levels	
55. Demand for workers	five levels	
56. Trend of wages	three levels	
57. Worker functions--data		ten levels
58. Worker functions--people		nine levels
59. Worker functions--things		eleven levels
60. Work fields		up to two
61. D.O.T. number	yes	old and new
62. General educational development	See items 34,35	six levels
63. Specific vocational preparation	See item 33	nine levels
64. Materials, products, subject matter		up to two

Appendix 1 (continued)

NOTES:

There is some redundancy among the categories of the 850 Titles File that must be worked out in its use.

The two data files described here are merged into one for operation within the ISVD.

In all cases there is a possibility that "not applicable," "no information" or some similar null message can be coded as appropriate.

Appendix 2

Relation of Occupational Titles of The 850 Titles File to Occupational Groups of The Forecasting File

The three digit coding of occupational groups shown below is used for forecasting and for certain summary statistics. The number of titles from the 850 Titles File that fall into each group is given in the right hand column.

Occupational Group Code Number	Group Title	Number of Titles in 850 File
100	Other Professional & Technical Workers	17
101	Accountants and Auditors	3
102	Airplane Pilots and Navigators	2
103	Architects	3
104	Workers and Teachers in Arts and Entertainment	15
105	Clergymen	4
106	Designers (ex. Design Draftsmen)	5
107	Editors and Reporters	9
108	Lawyers and Judges	2
109	Librarians	4
111	Personnel and Labor Relations Workers	4
112	Photographers	2
113	Social and Welfare Workers	2
120	Other Engineers	9
121	Aeronautical Engineers	1

Appendix 2 (continued)

Code Number	Group Title	Number of Titles in 850 File
122	Chemical Engineers	1
123	Civil Engineers	3
124	Electrical Engineers	6
125	Industrial Engineers	4
126	Mechanical Engineers	3
127	Metallurgical Engineers	2
128	Mining Engineers	1
130	Other Natural Scientists	3
131	Chemists	4
132	Agricultural Scientists	7
133	Biological Scientists	12
134	Geologists and Geophysicists	3
135	Mathematicians	2
136	Physicists	1
140	Other Technicians	3
141	Draftsmen	1
142	Surveyors	3
143	Air Traffic Controllers	2
144	Radio Operators	3
150	Other Medical and Health Workers	10
151	Dentists	1
152	Dietitians and Nutritionists	2
153	Professional Nurses	1

Appendix 2 (continued)

Code Number	Group Title	Number of Titles in 850 File
155	Optometrists	1
156	Osteopaths	1
157	Pharmacists	1
158	Physicians and Surgeons	2
159	Psychologists	3
161	Medical and Dental Technicians	5
162	Veterinarians	1
170	Other Teachers	4
171	Elementary Teachers	1
172	Secondary Teachers	1
173	College Teachers	2
180	Other Social Scientists	5
181	Economists	2
182	Statisticians and Actuaries	4
200	Other Managers, Officials and Proprietors	40
201	Railroad Conductors	2
202	Creditmen	2
203	Ships Officers, Pilots, and Engineers	6
204	Purchasing Agents	3
205	Postmasters and Assistants	1
300	Other Clerical Workers	26
301	Accounting Clerks	3

Appendix 2 (continued)

Code Number	Group Title	Number of Titles in 850 File
302	Hand Bookkeepers	2
303	Bank Tellers	1
304	Cashiers	2
305	Mail Carriers	1
306	Postal Clerks	2
307	Shipping and Receiving Clerks	2
308	Telephone Operators	3
310	Stenographers, Secretaries, and Typists	6
320	Office Machine Operators	15
400	Sales Workers	29
500	Other Craftsmen and Foremen	91
501	Bakers	3
502	Cabinetmakers	1
503	Cranemen, Derrickmen, and Hoistmen	6
504	Glaziers	1
505	Jewelers and Watchmakers	8
506	Loom Fixers	2
508	Opticians and Lens Grinders	5
511	Log and Lumber Inspectors	1
512	Other Inspectors	1
513	Upholsterers	3
520	Other Construction Craftsmen	9
521	Carpenters	2

Appendix 2 (continued)

Code Number	Group Title	Number of Titles in 850 File
522	Brickmasons, Stone and Tile Setters	4
523	Cement and Concrete Finishers	3
524	Electricians	2
525	Excavating & Grading Machine Operators	8
526	Painters and Paperhangers	2
527	Plasterers	2
528	Plumbers and Pipefitters	3
529	Roofers and Slaters	1
531	Structural Metal Workers	6
540	Other Foremen	(None explicitly)
550	Other Metalworking Craftsmen (except Mechanics)	20
551	Skilled Machining Workers	5
552	Blacksmiths, Forgemen, and Hammermen	5
553	Boilermakers	1
554	Heat Treaters, Annealers, Temperers	1
555	Millwrights	1
556	Metal Molders (except Coremakers)	3
557	Wood and Metal Pattermakers	3
558	Rollers and Roll Hands	3
559	Sheet Metal Workers	1
561	Toolmakers, Diemakers, and Setters	2
570	Other Mechanics and Repairmen	32
571	Airplane Mechanics	2
572	Motor Vehicle Mechanics	2

Appendix 2 (continued)

Code Number	Group Title	Number of Titles in 850 File
573	Office Machine Servicemen	1
574	Radio and Television Mechanics	1
575	Railroad and Car Shop Mechanics	1
580	Other Printing Trades Craftsmen	4
581	Compositors and Typesetters	5
582	Electrotypers and Stereotypers	2
583	Engravers (except Photo)	(None)
584	Photoengravers	7
585	Pressmen and Plate Printers	3
590	Other Transportation and Public Utility Craftsmen	10
591	Linemen and Servicemen	10
592	Locomotive Engineers	1
593	Locomotive Firemen	1
600	Other Semi-skilled Workers	113
601	Automobile Parking Attendants	(None)
602	Blasters and Powdermen	1
603	Laundry and Dry Cleaning Operatives	3
604	Mine Operatives and Laborers	1
605	Meatcutters (except Meatpacking)	3
606	Asbestos and Insulation Workers	1
610	Other Transportation and Public Utilities Operatives	4
611	Truck, Bus, and Tractor Drivers	4
612	Deliverymen, Routemen, and Cab Drivers	3

Appendix 2 (continued)

Code Number	Group Title	Number of Titles in 850 File
613	Railroad Brakemen and Switchmen	2
614	Power Station Operators	3
615	Sailors and Deckhands	(None)
620	Other Semiskilled Metalworking Occupations	4
621	Metalworking Assemblers	8
623	Furnacemen, Smeltermen, and Pourers	3
624	Metal Heaters	5
625	Machine Tool Operators	(None)
626	Metalworking Inspectors	1
627	Welders and Flamecutters	3
628	Electroplators	1
629	Electroplater Helpers	(None)
630	Other Semiskilled Textile Occupations	5
631	Knitters, Loopers, and Toppers	7
632	Textile Spinners	1
633	Textile Weavers	1
634	Sewers and Stitchers	2
700	Other Service Workers	10
701	Airline Stewards and Stewardesses	1
702	Hospital and Other Institution Attendants	2
703	Charwomen and Cleaners	(None)
704	Janitors and Sextons	2
705	Practical Nurses	1

Appendix 2 (continued)

Code Number	Group Title	Number of Titles in 850 File
710	Private Household Workers	(None)
720	Other Protective Service Workers	1
721	Firemen and Fire Protection Workers	1
722	Policemen, Detectives, Marshalls and Sheriffs	3
723	Guards, and Watchmen	2
730	Other Food Service Workers	1
731	Bartenders	1
732	Cooks (except Private Household)	2
733	Counter and Fountain Workers	1
734	Waiters and Waitresses	2
800	Laborers (except Farm and Mine)	(None)
900	Farmers and Farm Workers	14

Appendix 3

Summary of Datafiles on Occupations and Military Service Presently in the ISVD

File Identification	Number of Titles (approx.)	Number of Categories	Summary Description
850 Occupational Titles	860	56	See Appendix 1
DOT Supplement	13,800	27	See Appendix 1
Roe Groups	800	2	Roe Category and Level
Forecasting	160	160	High and low estimates of employment by year, 1960-80, for six selected industries (out of 120 possible industries)
Military enlisted	170	varies by service	About ten categories for each service
Military Officers	Not applicable	Not applicable	This information is presented in script form
References	10,000	1	Provides link to library of occupational information at Newton High School

Appendix 3 (continued)

Future development of datafiles in the ISVD can be expected to center around topics such as:

1. Local information and forecasts;
2. Career patterns (e.g., "job ladders");
3. Estimates of future relative demand by skill and type of training;
4. Information about industries;
5. Action steps needed to carry out occupational plans.

FORECASTING FOR COMPUTER AIDED CAREER DECISIONS: SURVEY OF METHODOLOGY

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Center for Studies in Education and Development
Harvard University

Technical Memorandum: 2

Harvard-NEEDS-Newton Information System for Vocational Decisions

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Notation and Format

THE BASIC DATA in occupational forecasting is handled in what is sometimes called an I-O matrix (Industry-Occupation)[1] which has *n* industries in the columns and *m* occupations in the rows. The cells of the matrix can be filled either with employment numbers e_{ij} which give the numbers employed in occupation i, industry j; or the cells may be filled with coefficients a_{ij} which give the percent or proportion of industry j's employment in the i^{th} occupation. It is customary to work with a base year matrix which gives the employment by occupation and industry for the base year; and a target year matrix which gives the employment by occupation and industry for the year of the forecast. If past trends are being extrapolated matrices for years before the base year may also be used, and years intervening between the base and target years may also appear in the calculations where pertinent. The point of all this is that time periods must be indicated in the notation. To summarize:

$B^t = \left[e^t_{ij} \right]$ B is a matrix of employment frequencies classified by occupation and industry in year t.

$A^t = \left[a^t_{ij} \right]$ A is a matrix of relative frequencies, i.e. the percent or proportion of employment in industry j, occupation i.

$a^t_{ij} = \dfrac{e^t_{ij}}{E^t_j}$ The a's are the proportion employed in industry j in the i^{th} occupation.

Subnational Forecasts

In forecasting from the base year (e.g. $t = 1966$) to a target year (e.g. $t = 1980$) the total employment in each industry (E_j) can change; the occupational frequency distribution within the industry (e_{ij}) can change; and, of course, the ratio of one to the other (a_{ij}) can change. In the ISVD project we are dealing with forecasts of employment in a sub-national area, i.e. New England. In most of our overseas operations we deal with a national area. The sub-national forecast is more difficult to make than the national one. At the national level non-systematic error tends to cancel because of the size of the population and the fact that it is less open-ended. The establishment of one major industry in a sub-national area, or the disappearance of one between base and target years, can throw estimates off considerably. Sub-national forecasts are also difficult because crucial data may not be disaggregated in detailed fashion for the area under study.

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[1] The industries in the columns are classified by some standard system, usually SIC (Standard Industrial Classification) taken to at least two and sometimes three digits. Occupations may be classified by the Census system or by the DOT (Dictionary of Occupational Titles), and specialists are preparing standard tables for converting from one to the other.

Method One

The first method is a very simple one. The employment established by census or survey in the base year is simply carried forward to the target year. The assumption is that there will be no change: $e_{ij}^{1966} = e_{ij}^{1980}$
Total employment for all occupations and industries in 1980 is simply:

$$\sum_{j=1}^{n} \sum_{i=1}^{m} e_{ij}^{1980}$$

Method Two

In basic method Two the operation is equally simple minded. Employment in the target year grows by some amount but the distribution coefficients remain the same as in the base year.

$$a_{ij}^{1966} \; E_j^{1980} = e_{ij}^{1980}$$

Apart from the problem of assuming the same distribution for the target year as the base year, there is the question of where the employment totals by industry come from. These may come from various sources and be derived by various methods:

Method Two A

$E_j^t = \dfrac{\text{Output Industry j}}{\text{Output per head}}$ If the ratio of output to output per head is projected from the base year to the target year then one has employment for the target year. This simple statement covers up considerable complexity and difficulty but it shows the essentials of the method. The numerator, i.e. output (product, or value added expressed in money or sometimes in physical terms) may, hopefully, be available through the courtesy of some economist. How accurate and precise this output estimate is depends on the economist, his data, assumptions and work habits. The guidance specialist may prefer not to inquire too deeply into the matter.

The economist may derive his output from a complex input-output analysis which gives him demand for the industries in question and permits him to relate demand to output. The economist may also simply slap some growth factor to the base year output and run it up. In the sub-national estimate there are all the usual complications and input-output analysis gets pretty messy when the economist has to determine export and import (domestic primarily) relationships for some sub-area. The economist may also get his estimate for the sub-area from the national forecasts or base it on growth observed in some other sub-area.

The economist may estimate output very crudely for industry j by this relationship:

$$O_j^{1980} = (1 + r)^{14} \cdot O_j^{1966}$$

Here output in the forecast year, 1980, is derived from multiplying output in the base year by a cumulative annual growth factor (an annual percent increase raised over the years of the forecast; in this case, 14). Where does the growth factor come from? It may simply be guessed or be supplied by some expert in the industry, or it may be derived from past performance in the industry in two previous years.

$$(1 + r) = \sqrt[10]{\frac{O_j^{1960}}{O_j^{1950}}}$$

Here we suppose that the forecaster has output of the industry in 1950 and in 1960. He can find the annual percent increase by looking up the ratio of output of the two years in a table of compound growth factors.

There are real problems in the denominator too. To get good estimates of output per head, sometimes called productivity, one has to have all the information an economist can get plus more that only an engineer or expert in the technology of the industry can furnish. Productivity will obviously depend on the technology used in the industry and this may change rapidly over the forecast years. Usually expert opinion within each industry gives reasonable bases for estimates. Or one can extrapolate from the past or borrow from comparative models. These latter techniques will be discussed more fully in connection with later methods.

Method Two B

Growth of employment in industry j for the sub-national area is borrowed directly from growth of employment already estimated for industry j for the nation. Such national growth estimates for industries are usually available and the rest is simple:

$$\frac{{}^{n}E_{j}^{1980}}{{}^{n}E_{j}^{1966}} = {}^{n}P_{j}$$

Where ${}^{n}P_{j}$ is national growth factor in industry j.
n = national
l = local

$${}^{l}E_{j}^{1980} = {}^{l}E_{j}^{1966} \cdot {}^{n}P_{j}$$

$${}^{l}e_{ij}^{1980} = a_{ij}^{t} \cdot {}^{l}E_{j}^{1980}$$

Method Three

In method Three there is an attempt to derive the a_{ij} coefficients by some rational or analytic means. There are two primary sources for this. The first basis is the history of the local area economy in the past and the assumption that this will follow an identifiable trend in the future. The second basis is the history of an economy which may be taken as a model for estimating how the economy under study will behave.

Method Three A: Historical Trends

The forecaster has the A matrices for various time periods in the past:

$$\left[a_{ij}^{1940} \right]_{m,n} \quad \left[a_{ij}^{1950} \right]_{m,n} \quad \left[a_{ij}^{1960} \right]_{m,n}$$

He then fits a curve to the a_{ij}'s over the time periods and obtains a matrix in which the elements are a function of time. If $U_{(t)}$ is that matrix, then:

$$U_{(t)} = \left[f_{ij}^{(t)} \right]_{m,n}$$

Where: f_{ij} is the curve fitting the corresponding a_{ij}'s over the time periods 1 . . . k

If the total employment in all industries is known for some time period t, then we can form an n x 1 vector of these employments and denote it:

$$V^{t} = \left[E_{j}^{t} \right]$$

The m occupational employment levels at t can be denoted by an m x 1 column vector:

$$W^{t} = \left[R_{i}^{t} \right]$$

$$W^{t} = U_{(t)} \cdot V^{t}$$

Or in expanded form:

$$\begin{aligned} R_1 &= f_{11}(t)E_1^t + f_{12}(t)E_2^t + \ldots\ldots\ldots + f_{1n}(t)E_n^t \\ &\cdot \\ &\cdot \\ &\cdot \\ R_m &= f_{m1}(t)E_1^t + f_{m2}(t)E_2^t \ \ldots\ldots\ldots + f_{mn}(t)E_n^t \end{aligned}$$

The algebra shows perfectly well that this is a very long way from being very satisfactory analytically. First, to make it work the forecaster has to have V^t for the forecast year, i.e. he has to get the total employment for each industry from some method such as Two A or Two B. Secondly, the soundness of $U_{(t)}$ depends on the extent to which the trends of the past may be carried into the future. The only straightforward things are the techniques for fitting the curve function and even these can be artsy-craftsy.

Method Three B

In method Three B the forecaster uses the comparative or "other model" method. There are two possibilities, neither of them very good.

In the first the forecaster assumes that the trends of the a_{ij}'s in his local area will be the same or close to those observed in another area. This works fairly well when one selects the economy of a developing country as a possible model for an underdeveloped one. Even then it is full of pitfalls. In the present situation it would involve using one state, region or SMSA as a model for another. We are forecasting for New England which has a pretty sophisticated and advanced industrial base and it is pretty difficult to think what the advance model would be. This approach appears useless.

In the second variant the forecaster uses a bunch of like industries to derive the e_{ij}'s through regression analysis.

$$R_1 = \sum_{j=1}^{n} e_{ij}$$

The model would be:

$$R_1 = b_{11} E_1 + b_{12} E_2 + \ldots + b_{1n} E_n$$

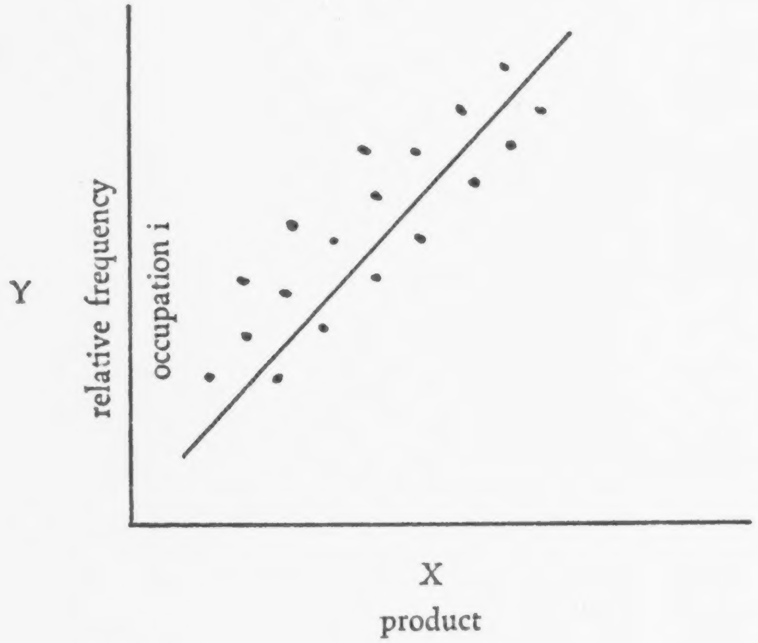
R_1 would be the number employed in occupation 1 in the various industries $E_1 \ldots E_n$. The b coefficients would be derived from regression analysis which would yield the relative frequency of employment in the i^{th} occupation, j^{th} industry. The basic model would show this relative frequency as a function of product or output in the industry. In simplest form the expression would be:

$$b_{ij} = f(X_j)$$

where:

b_{ij} = relative frequency of occupation i in industry j

X_j = product or output in industry j



A number of similar industries using occupation i would be graphed for product and for relative frequency of occupation i, and the coefficient b derived by least squares. The analysis is somewhat more complex than

this suggests but these are the basic notions. The advantage of this method is that the coefficients are known for various industries in the United States and other countries and could be applied to yield useful results in gross form. The output for these industries is also likely to have been forecast for future years and the two could be put together.

Other Methods: Check Methods

There are other so-called methods which are more useful for checking and adjusting results than for obtaining them but we can call them methods.

Method Four

In method Four industries are grouped into Primary (agriculture, mining . . .), Secondary (manufacturing) and Tertiary (services) and the relative employment in these three large groupings can be compared. Various combinations of the sectors can be set up to reflect how the economy may be presumed to look in the future, i.e. characterized by predominance in one or more of the large sectoral groupings. For example, the economy might be predominantly characterized by employment in the Primary sector with low employment relatively in the other two. There would be seven ideal combinations ($2^3 - 1$) inasmuch as no one would forecast an economy which was low on all three. The employment projected by one of the other methods can be checked against this characterization. The group percentages can also be checked against the economies of other regions or other states or the national economy.

Method Five

In method Five the same aggregations are done on the basis of occupations. Instead of very detailed two or three digit groupings, much larger groupings are set up. One common one is dividing the occupations into White Collar, Blue Collar, Service Workers and Farmers. This is a common one and a poor one. A better one is to divide them by levels of education or training, e.g. College-University, Secondary-Vocational, Secondary-General, Primary School. There are data which can be used to check the results.

Both of the check methods provide ways of testing out results obtained from other forecasting methods. The percent distributions from the U. S. as a whole can be compared to the ones obtained for the local area.

Necessary Extension of the Methods

These conventional methods must be extended, refined and enriched before they will serve in computer aided career decisions. Minimally, these additions are necessary:

1. The identification of growth cones within sectors of the economy must become more precise. Within sectors, industry groups, industries, and even specific establishments must be identified as candidates for growth. Hence, forecasting must trend toward placement, but stop somewhere short of it.

2. The future of specific occupations may not be as significant as the identification of potential paths of occupational change and mobility. This may mean regrouping occupations according to common elements, e.g. trait, skill and interest requirements, which may be identical or similar. If occupation A and occupation B intersect in all, or virtually all, of their characteristics then the future of A is bound up with B; if there is no illogical constraint on moving from one to the other then they should be grouped for forecasting purposes. If A and B are alike in some elements but unlike in others, e.g. B has all the requirements of A plus a few more, then the subject should be informed of the future potential of B, if this is the case, and advised on the means for acquisition of those additional requirements. This is only to say that present forecast methods are excessively nominal, and to be of any use forecasting must be more substantive.

3. The criteria for determining future promise in occupations or industries must be extended beyond estimates of employment growth. The employment forecast results must be weighted by increases in salaries and benefits, improvement in working conditions and increased status and prestige. These often move together, but not always.

4. Increased salary and worker benefits, improvements in working conditions and increased status and prestige may presumably reflect enhanced productivity which in turn may require more education, training and skill. These future costs to the candidate for future benefits from the job must also be incorporated in the forecasts.

Methods of Extending the Methods

1. More precision in identifying growth potential. This requires work at a greater level of disagregation insofar as industries and establishments go. This brings greater dangers of inaccurate estimates inasmuch as unforeseen events can radically affect the fortunes of individual industries and establishments. For this reason estimates on growth will have to be hedged or tied to explicit assumptions, or results must be expressed in probabilities with wide error limits attached. Detail may be gained at the cost of accuracy, but there is probably also an advantage of explicit estimates having more meaning to candidates. Nothing for nothing.

2. Occupational linkage analysis. The need for occupational classification analysis was stated from the outset and the methods for sorting and analysis described in another paper.

3. Opportunity weighting. This can be handled by building value or opportunity weights into the final estimates. Some factors, e.g. prestige, may be difficult to quantify, but subjective weightings can be established and validated.

Overall the likelihood is that forecasting will get less quantitative and more subjective as the project goes along, but to stop at the present level of development is to settle for something less than full utility.